

Ablationsbehandling av VES och VT

Csaba Herczku

Regional fortbildningsdag i Kardiologi

2026-10-02



Ventrikulära arytmier

- Strukturellt frisk hjärta, därmed idiopatiska
 - Benigna former
 - Maligna former
- VES/VT hos patienter med strukturella hjärtsjukdomar
- Kanalopatier (långa QT, Brugada syndrom, Katekolaminerg polymorf VT, kort QT)



Lyckandefrekvens vid kateterablation av VT

Resultat varierar kraftigt beroende på underliggande hjärtsjukdom och hjärtats struktur.

Idiopatisk VT

Strukturellt normalt hjärta

>90%

AKUT FRAMGÅNG

Långsiktigt fria från återfall i 75–80% av fallen. Mycket god prognos.

Ischemisk VT

Efter tidigare hjärtinfarkt

75-89%

AKUT FRAMGÅNG

Ärrvävnad komplicerar ingreppet. Ca 47–57% är helt VT-fria efter ett år.

Icke-ischemisk

Kardiomyopati / hjärtsvikt

66-88%

AKUT FRAMGÅNG

Komplexa ärrmönster ger lägre långsiktig frihet från VT (23–43%).

Fascikulär VT

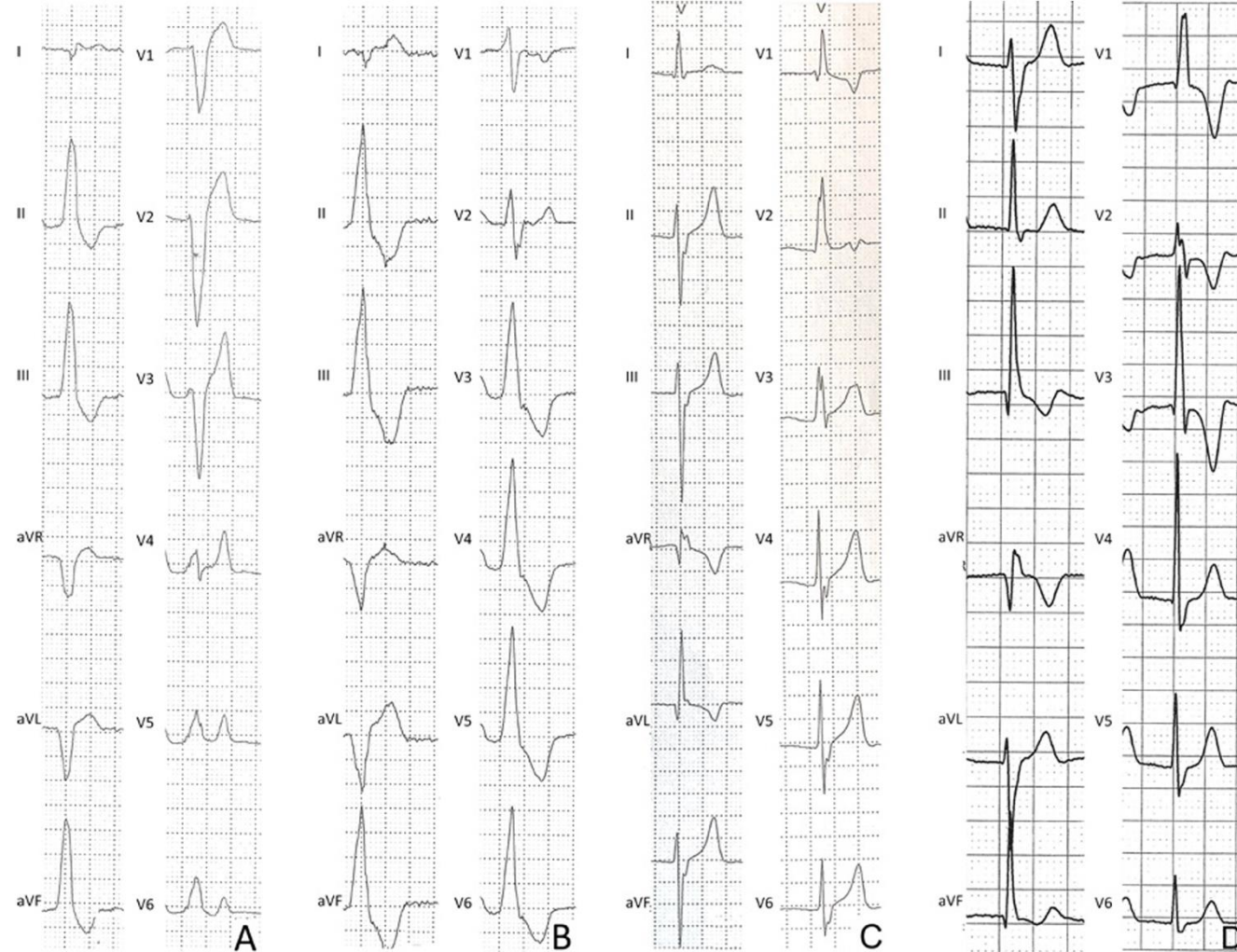
Specifikt retledningssystem

>93%

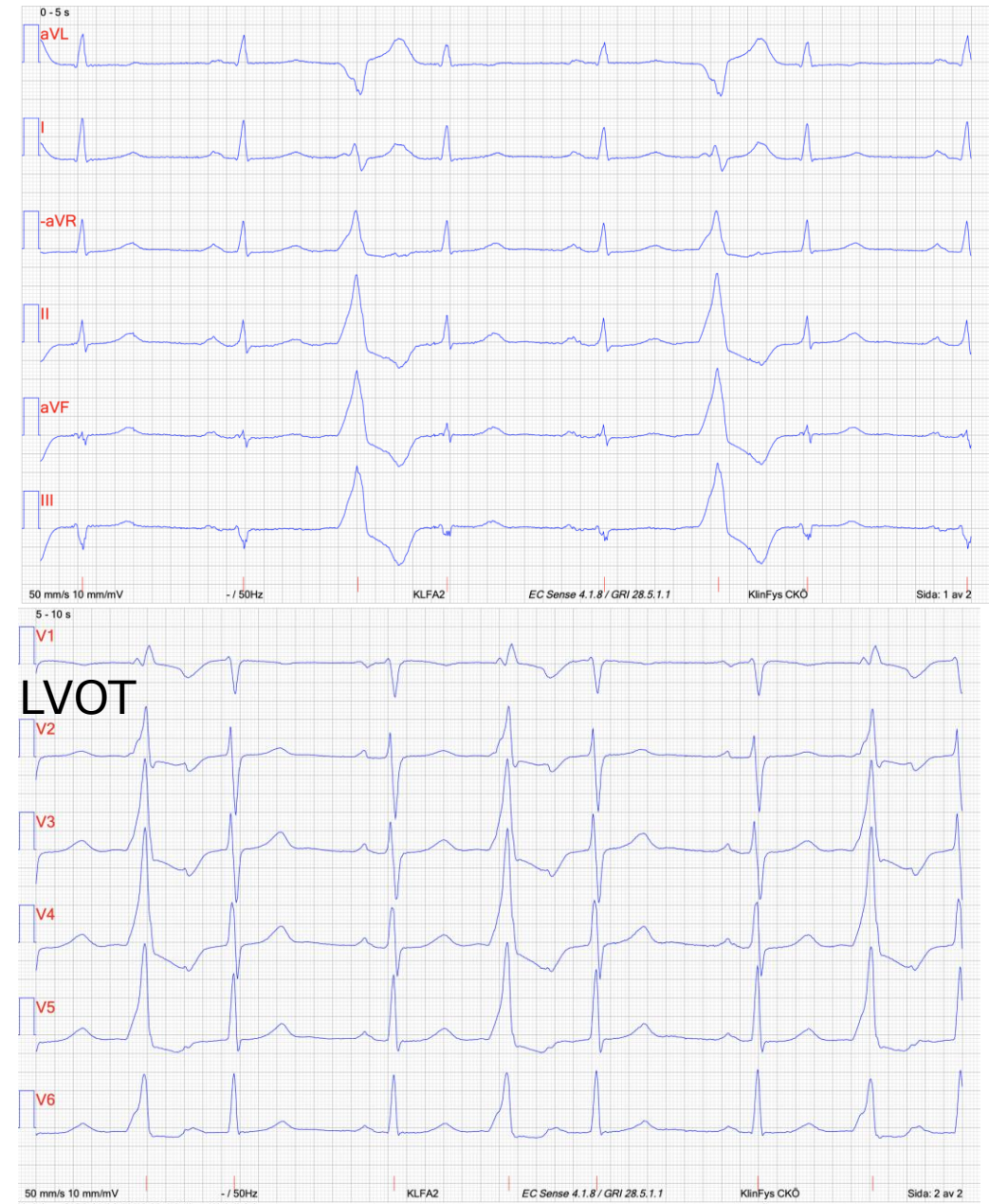
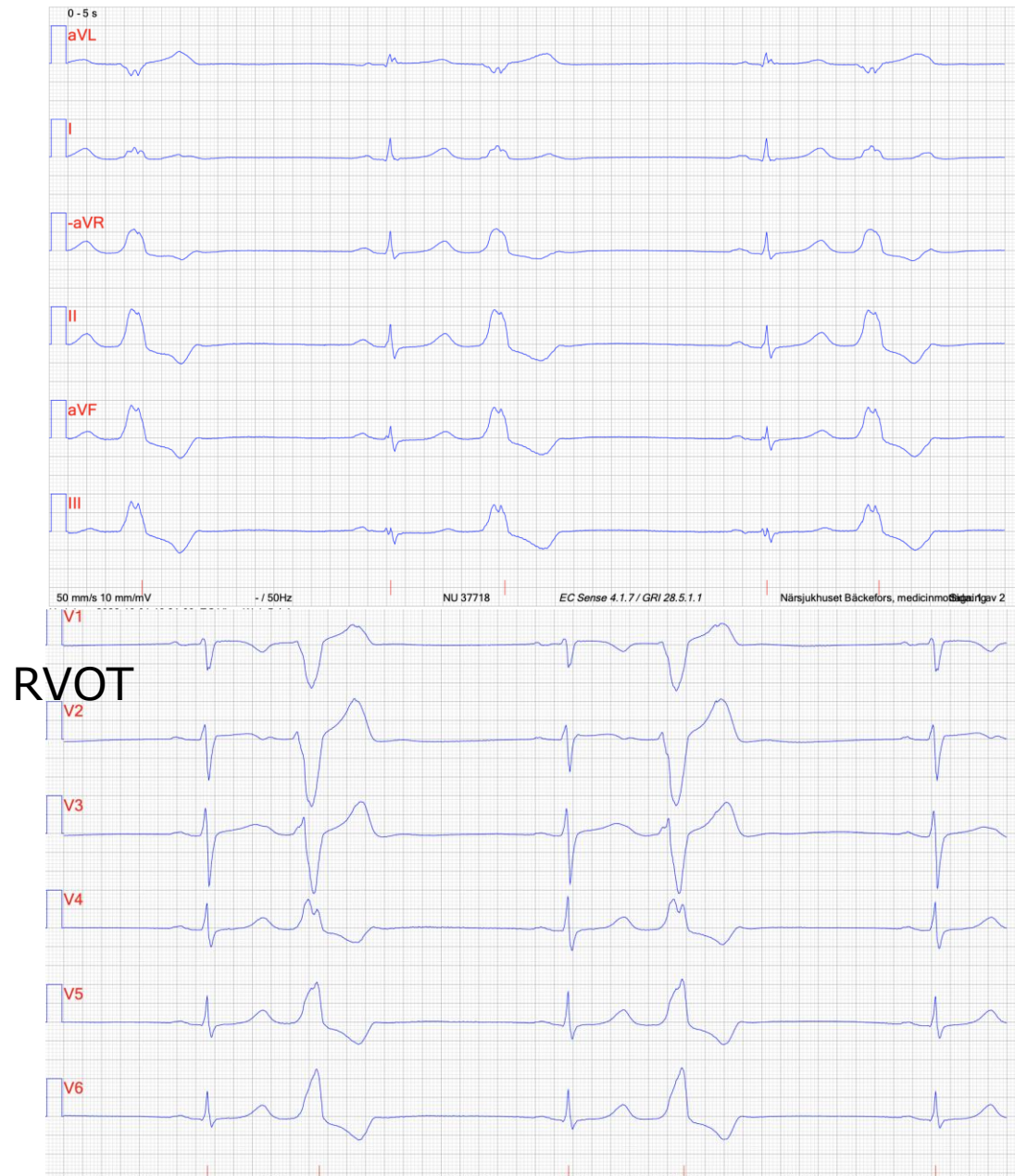
LÅNGSIKTIG SUCCÉ

Hög framgångsgrad, ofta efter en eller ett fåtal procedurer.

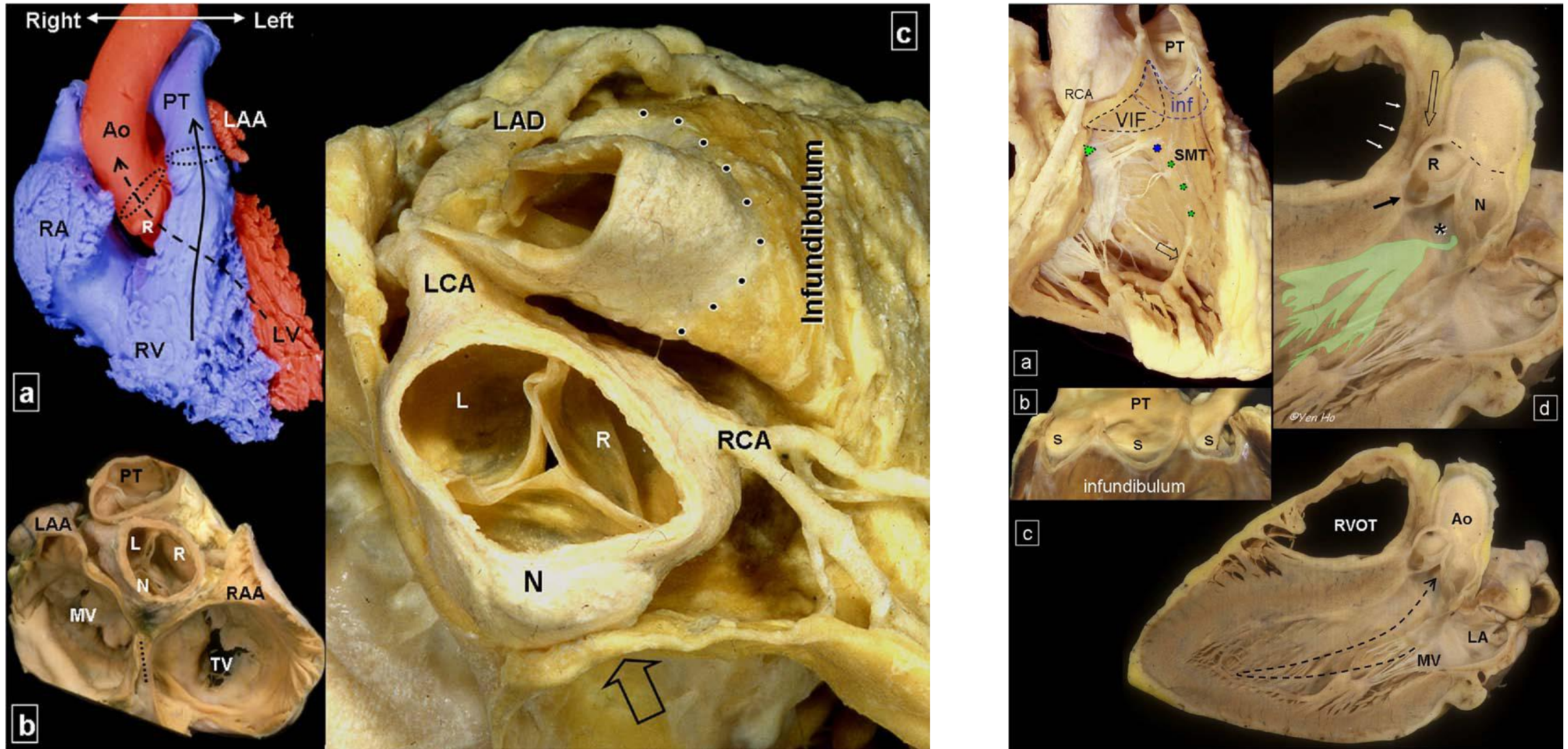
Ventrikulära extrasystolier/nsVT, benigna former



Ventrikulära arytmier från utflödestraktet cAMP medierad triggered aktivitet, DAD

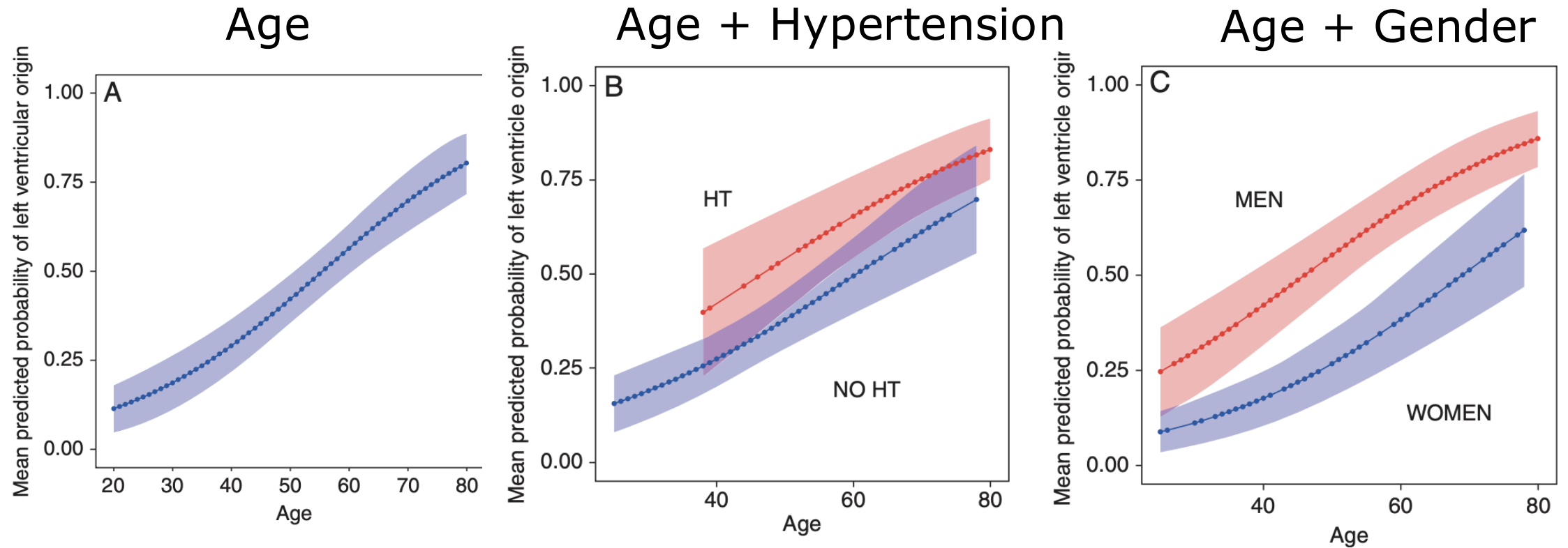


Anatomi av utflödes trakt



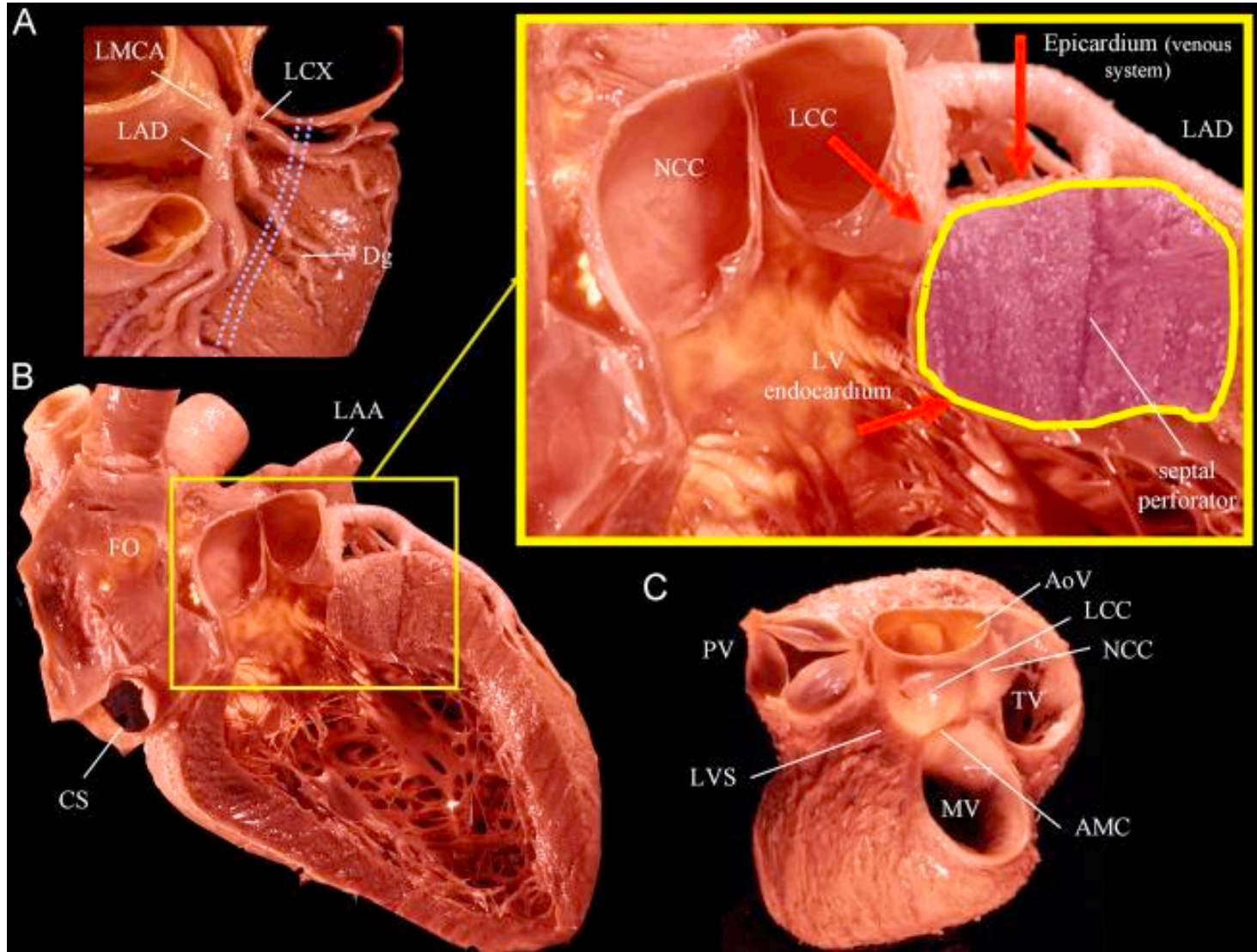
Siew Yen Ho, PhD, FRCPath. **Anatomic insights for catheter ablation of ventricular tachycardia** (Heart Rhythm 2009;6:S77-S80)

Kliniska prediktorer för LVOT ursprung

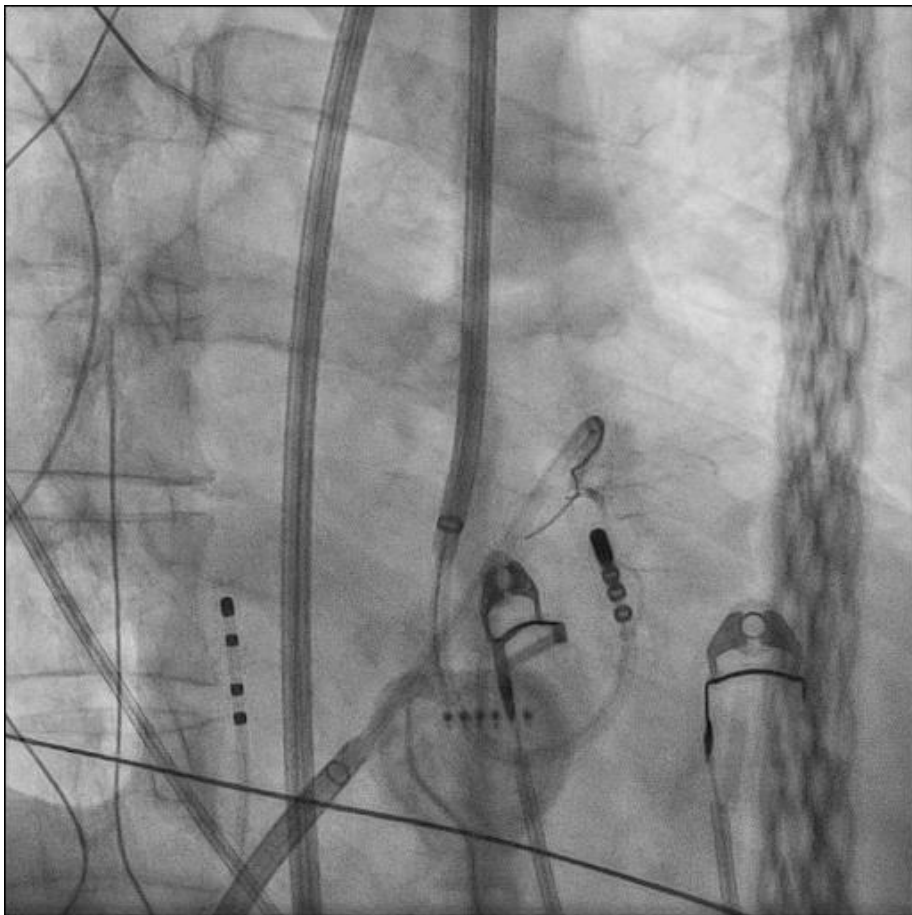


D. Penela et al. Europace (2015) 17, 1122–1128

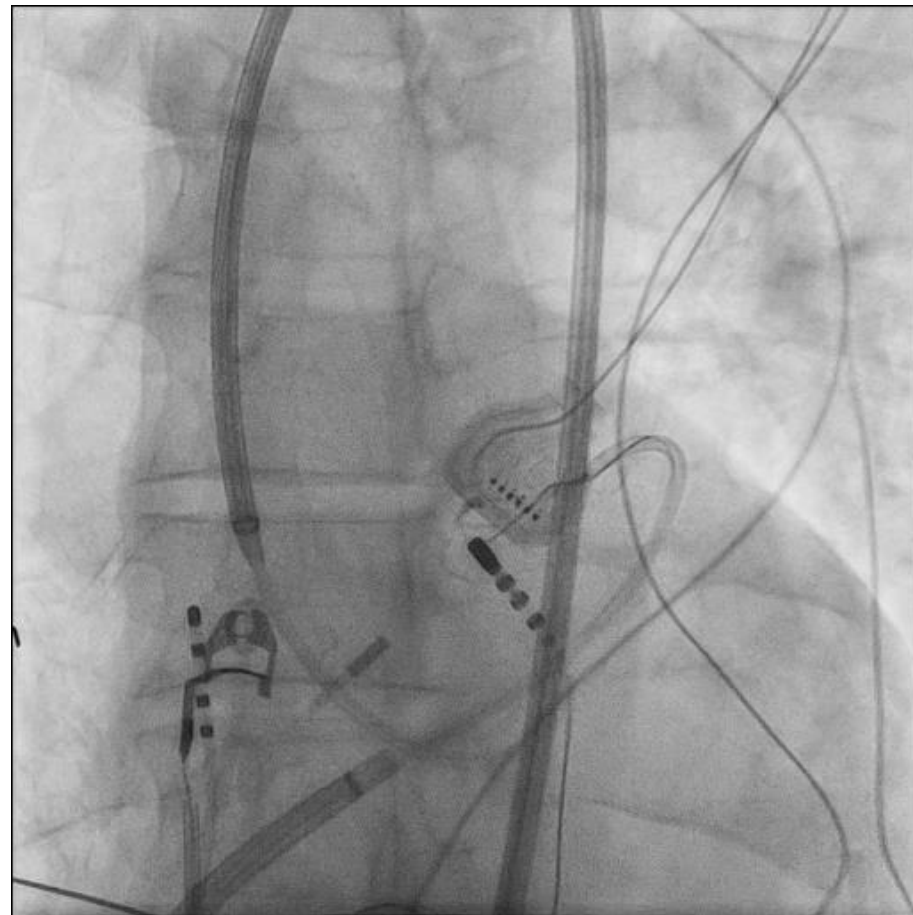
LV summit VES, anatomy



Ethanol ablation

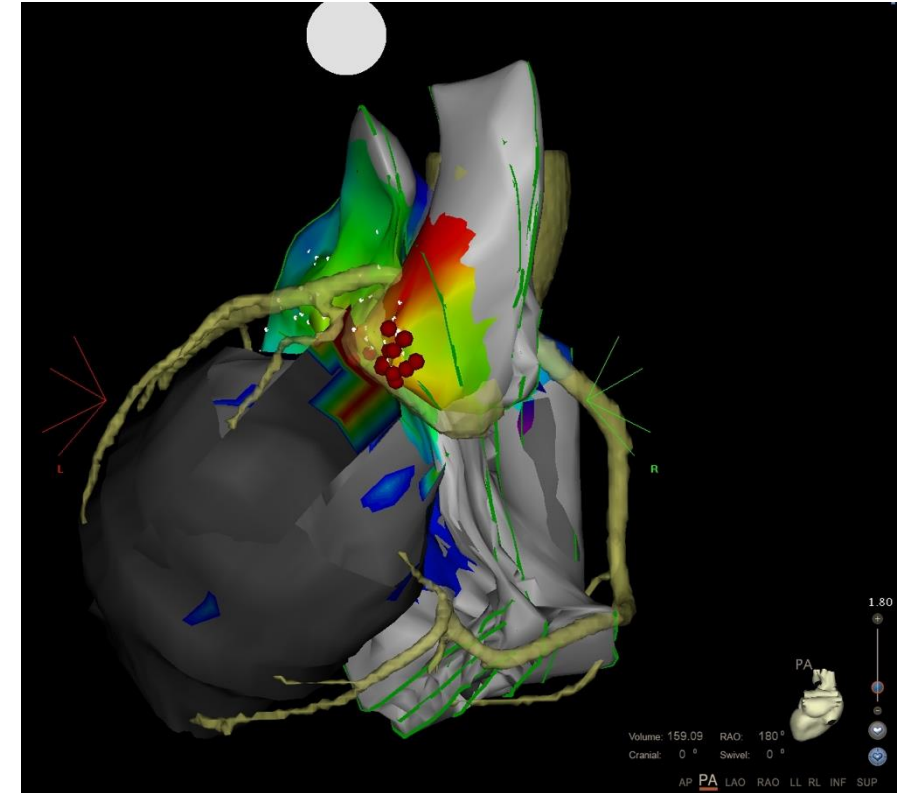
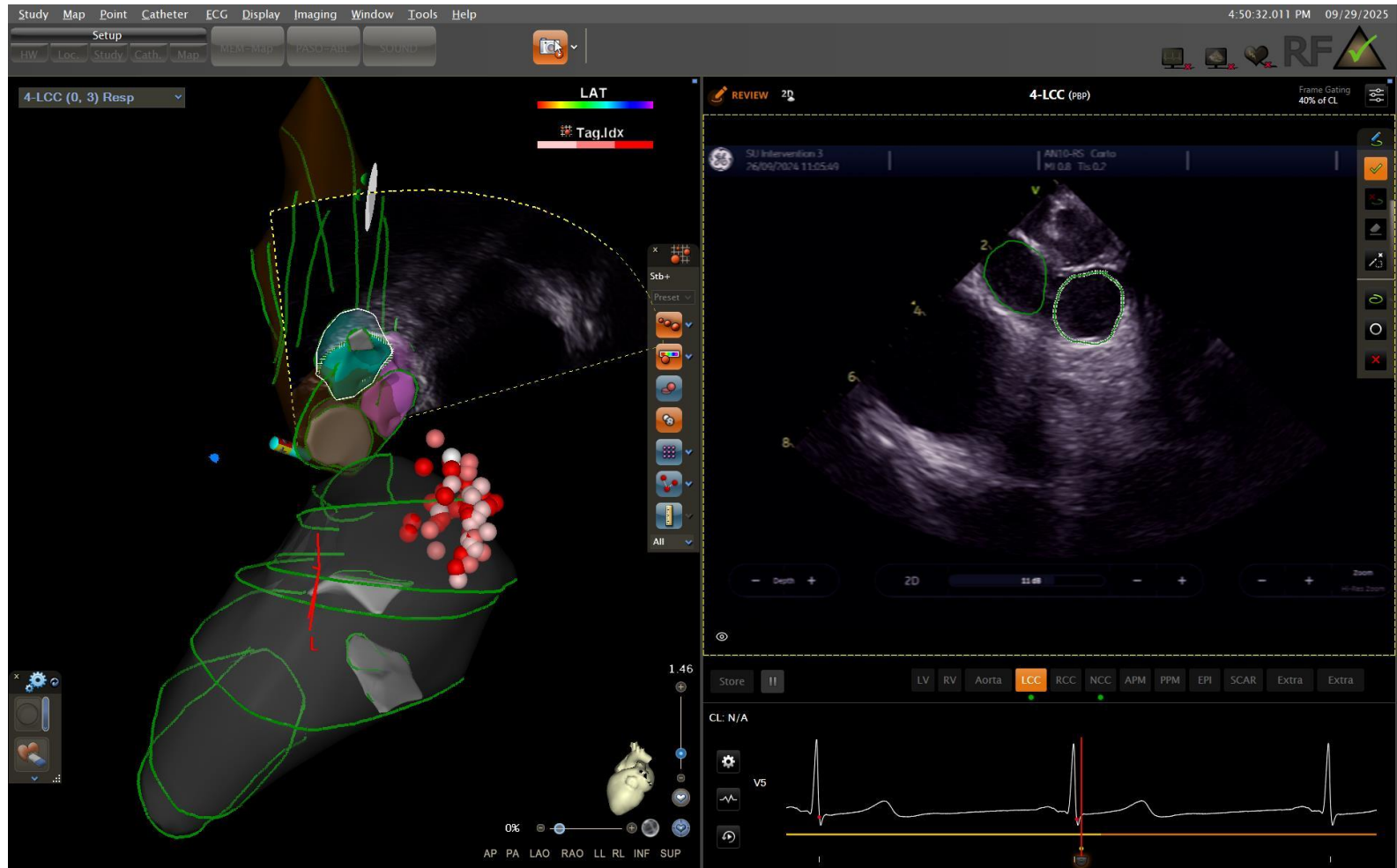


RAO



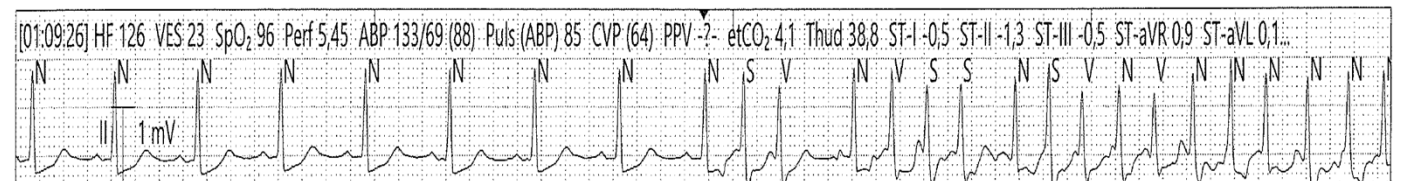
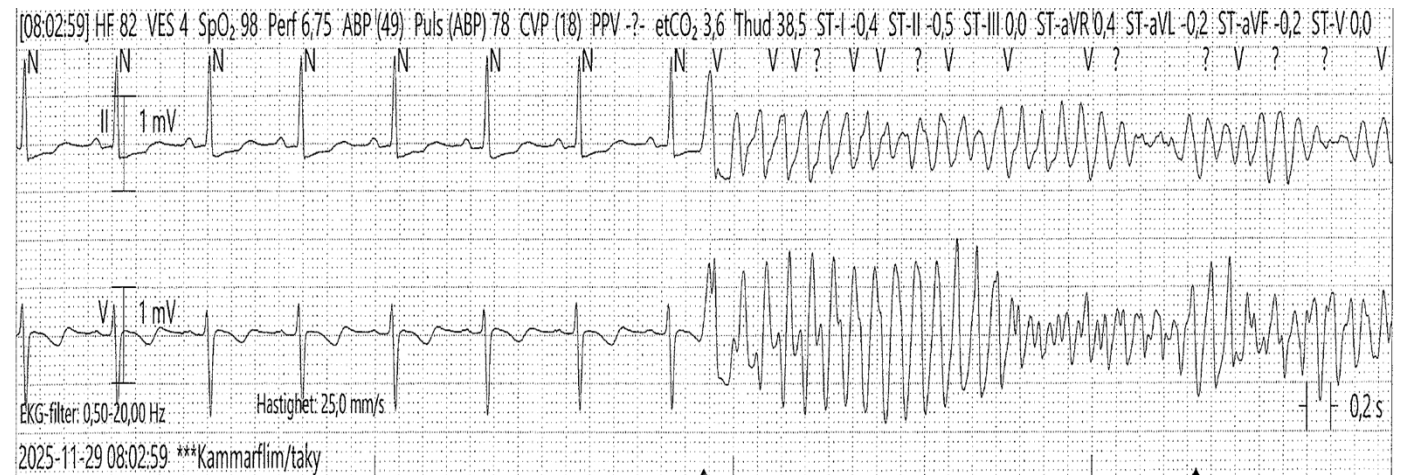
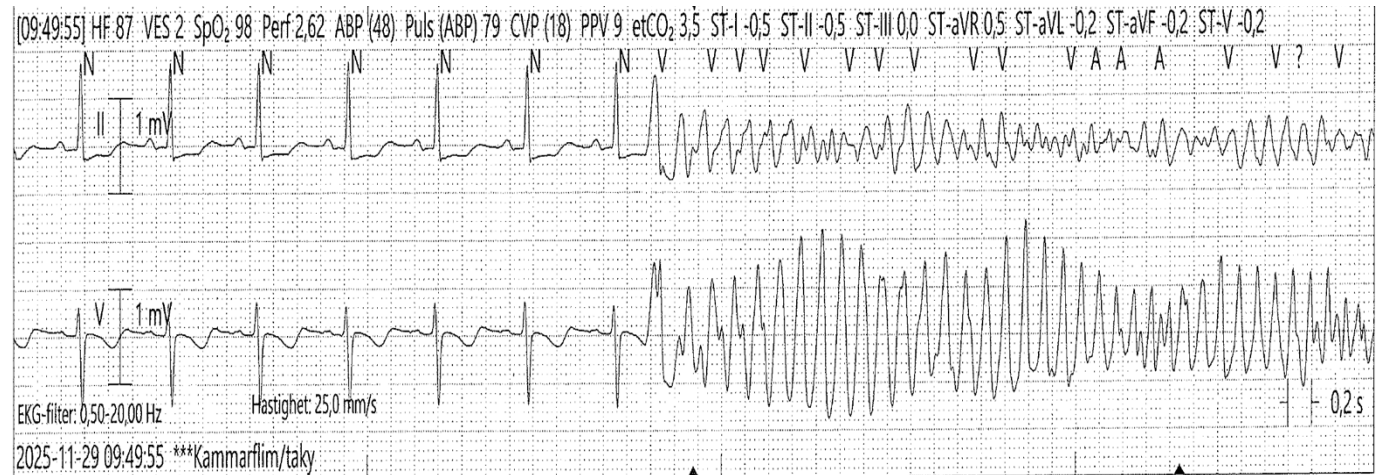
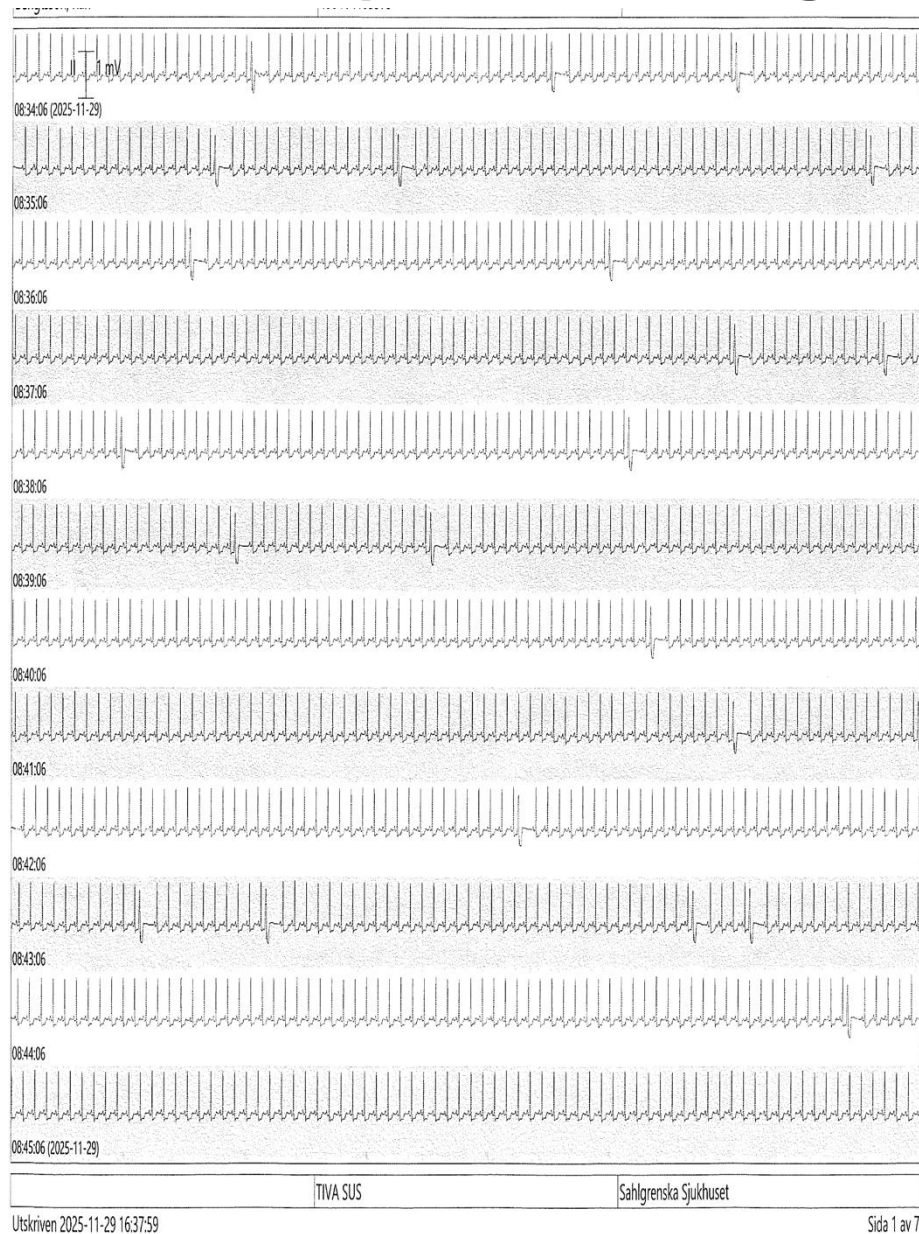
LAO

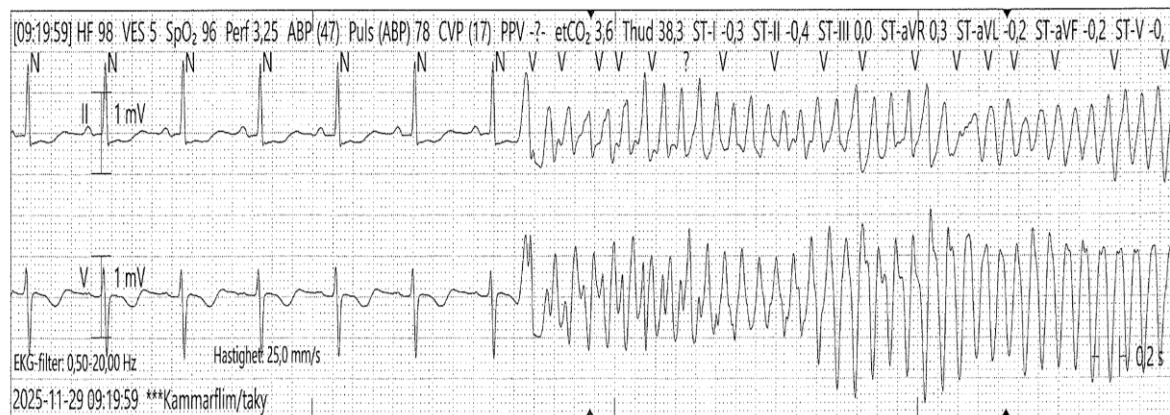
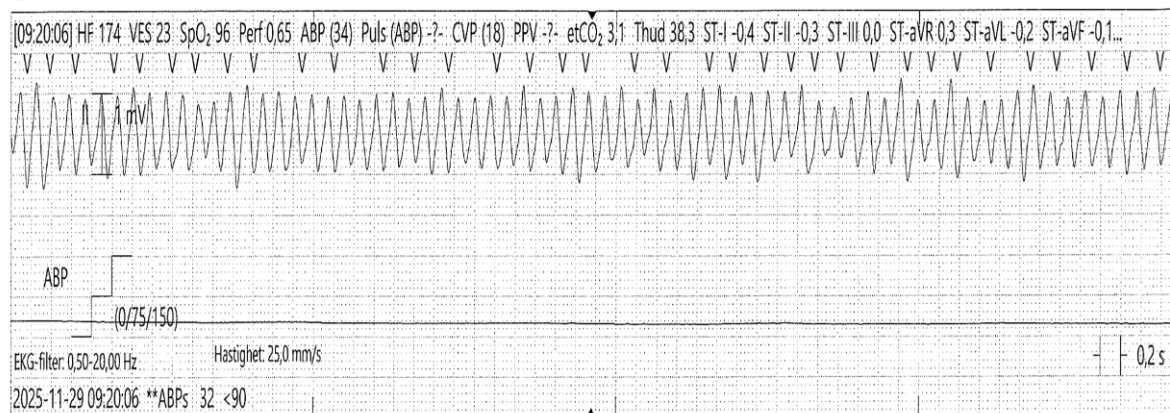
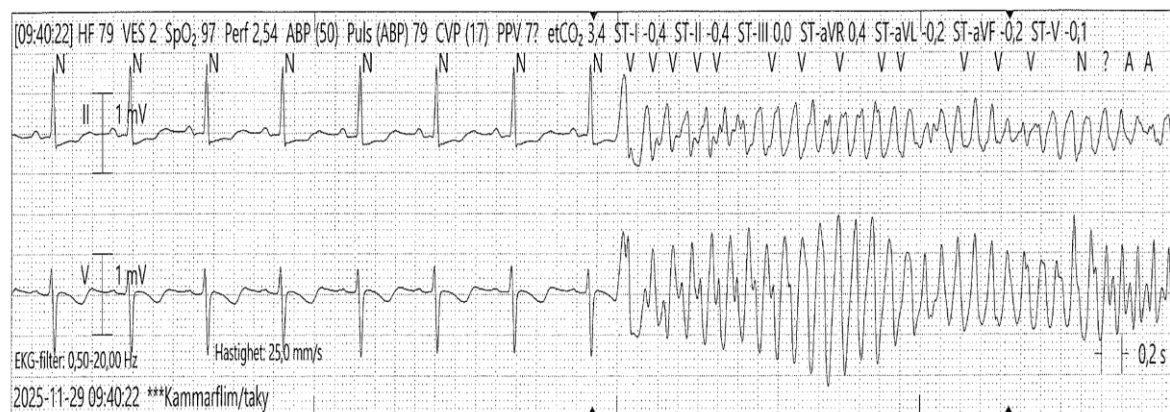
Intrakardiell ultraljud för att hjälpa ablationen



Fusion of CT-angio
and 3D ultrasound

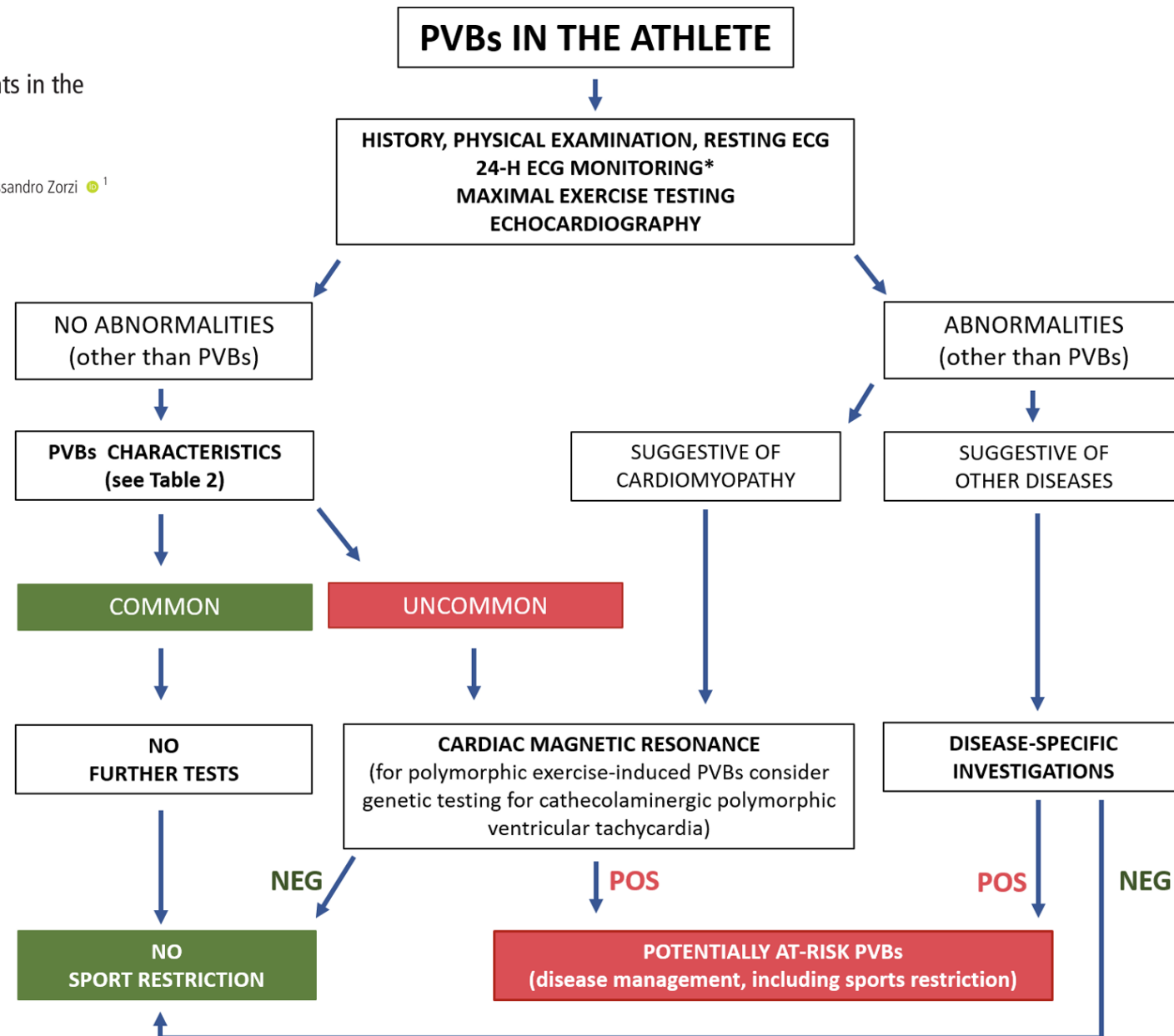
Finns tyvärr malignant form också





How to evaluate premature ventricular beats in the athlete: critical review and proposal of a diagnostic algorithm

Domenico Corrado,¹ Jonathan A Drezner,² Flavio D'Ascenzi ,³ Alessandro Zorzi  ¹



Holter EKG

- 1. Monomorf eller polimorf
- 2. Singulär eller repetitiva former (kopplad, triplett, nsVT)
- Komplex arytm i form av polymorfisk nsVT
- Frekvens av nsVT
- Koppling interval



Koppling interval och frekvens

- Kortkopplade VES, men ingen riktigt cut-off
 - Haissaguerre: 355 ± 30 msek, Viskin: 340 ± 30 msek, Noda 409 ± 62 msek i maligna former med i benigna former 427 ± 76 msec
- Viktigt: QRS varaktighet, cut-off 120-130 msek
- VT cykellängd: Noda et al. Malignanta former: 273 ± 23 benigna former: 328 ± 65 msec.

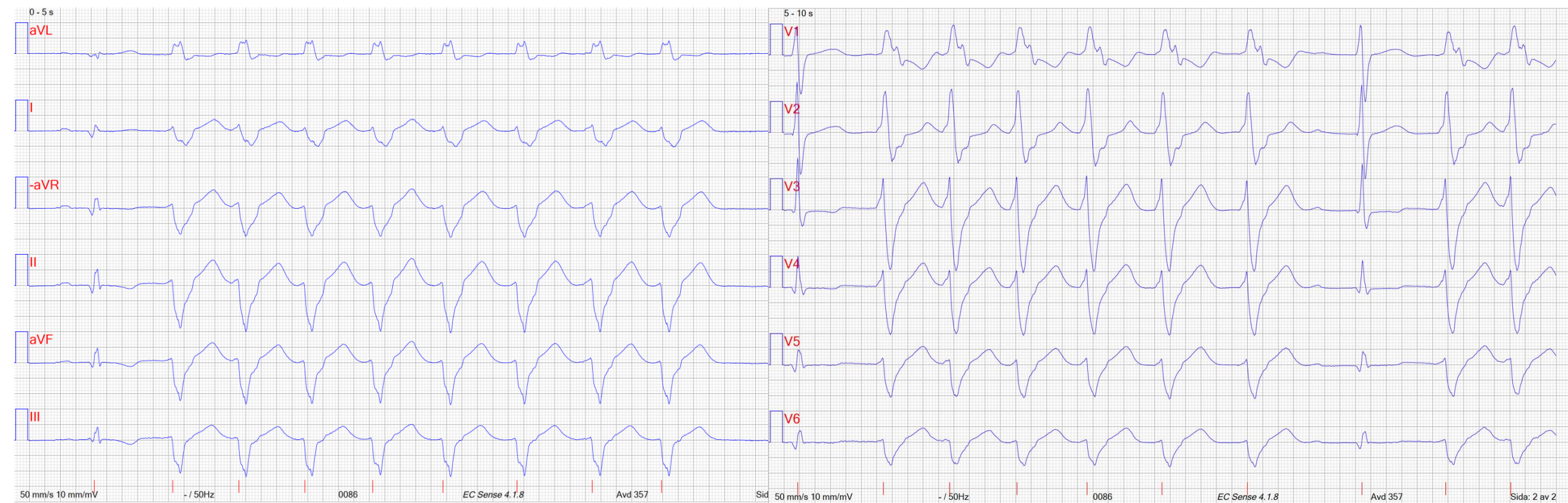
VES orsakad kardiomyopati, när förväntas?

- I fall man hittar nedsatt EF VES burden är högre, 29-37 % versus 8-13 %, men finns inget absolut cut-off
 - Niwano et al: 20000 VES/24 timmar
 - Baman et al: > 24 % VES med 79% sensitivitet och 78 %-os specificitet signerat nedsatt vänsterkammars funktion
- Munoz et al: RVOT vs LVOT ? I fall av RVOT ≥ 10 %, vid LVOT ursprung ≥ 20 % PVC burden behövdes
- Andra faktorer: QRS bred (>140 msec) och morfologi (splittrad QRS), koppling interval (≤ 600 msec), retrograd överledning

Arbets EKG

- Ska utföras upp till max kapacitet
- VES under arbetet
 - I benigna former minskar eller försvinner under max belastning, blir aldrig mer komplex
 - I maligna former: kommer oftare, ökad komplexitet, eventuellt bidirektionell VES

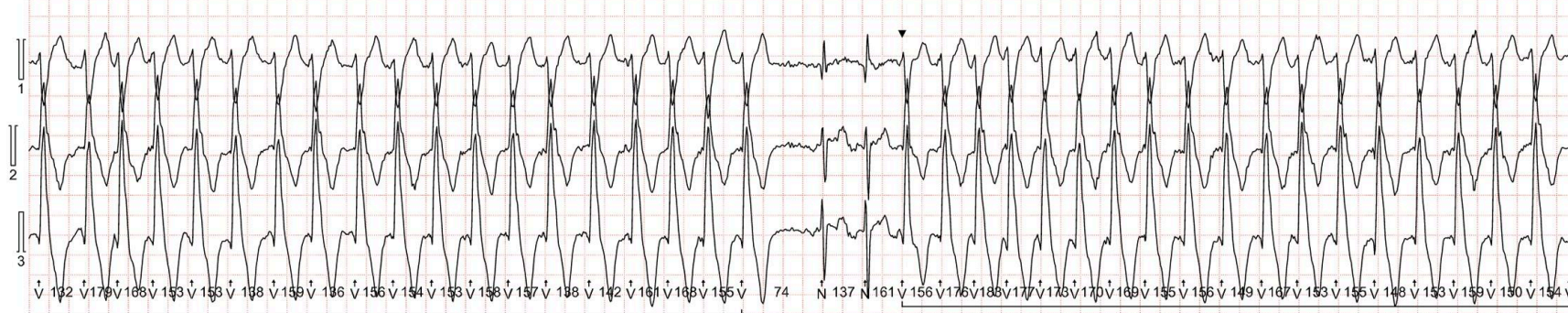
12 avl EKG, VES från den posteriora papillarmuskeln



Holter EKG

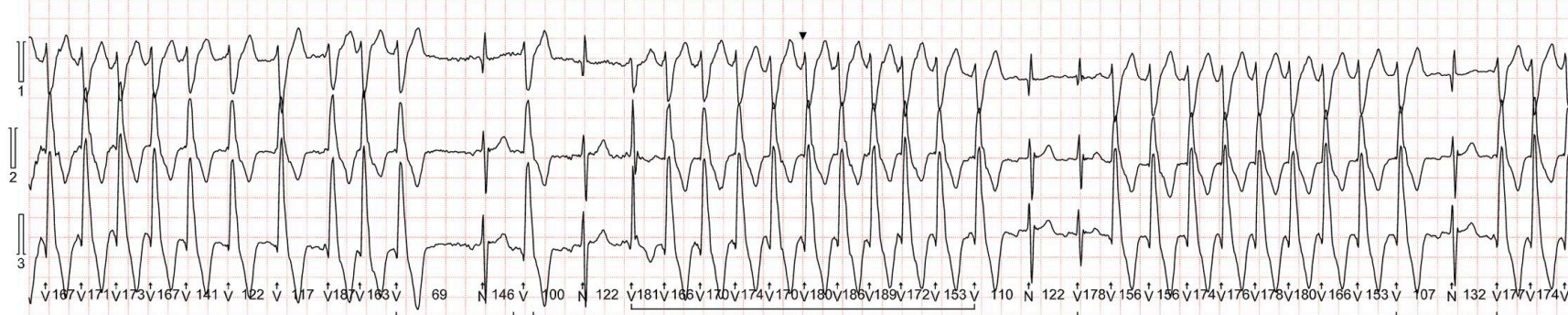
mån 05, 15:43:46 VT 231 slag 180 spm topp (Händelsens start) 1 min HF 154 SPM

25 mm/s (Skala: 1:2)



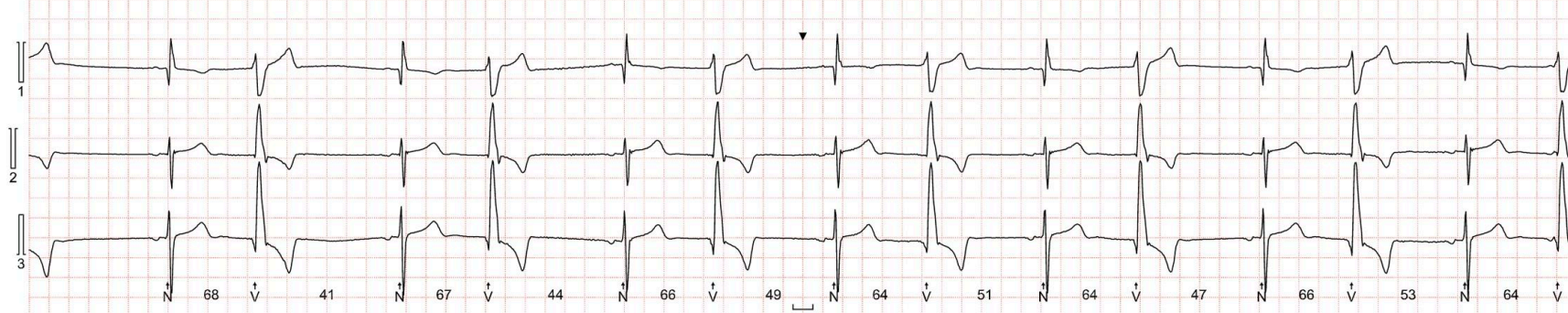
mån 05, 16:03:30 VT 11 slag 187 spm topp (Händelsens mitt) 1 min HF 160 SPM

25 mm/s (Skala: 1:2)

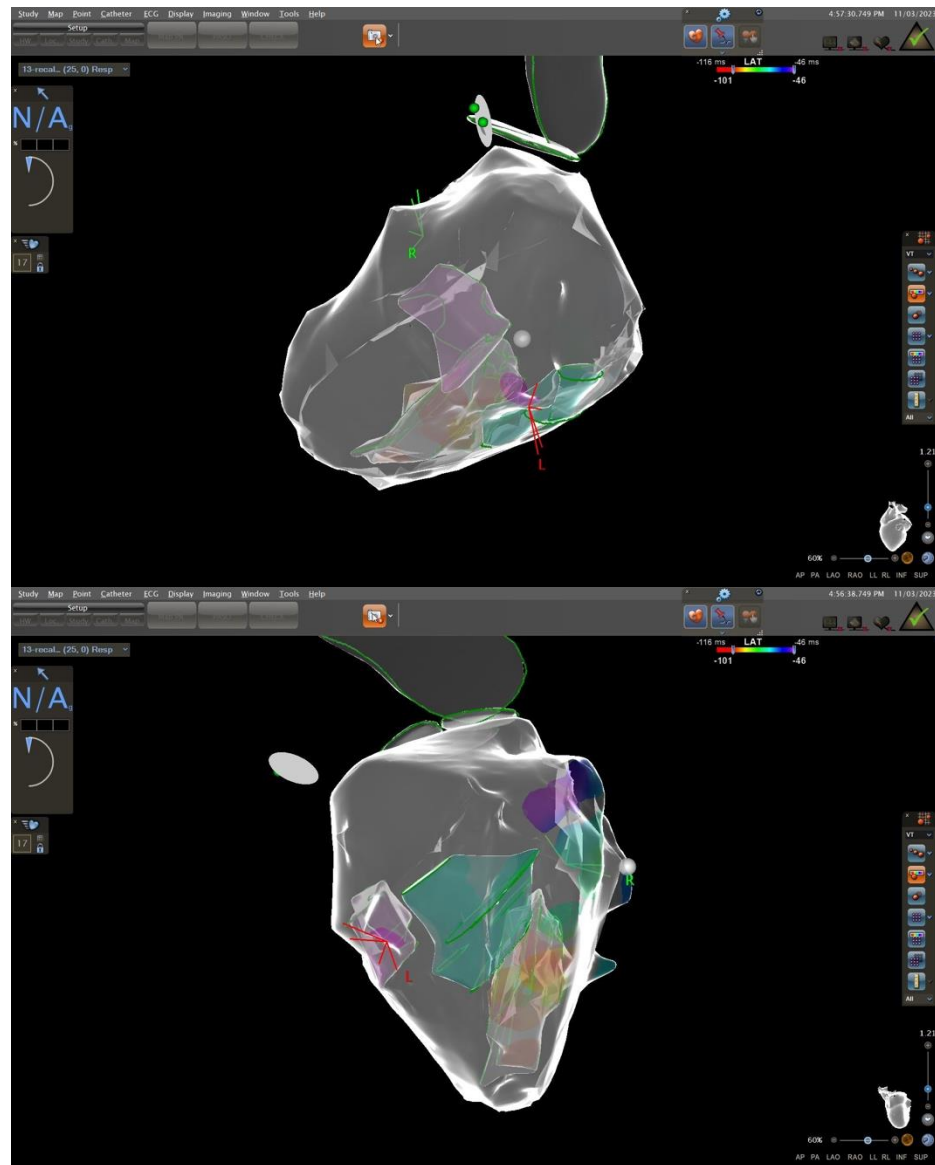


tis 06, 09:19:10 Operatörsvald händelse (Händelsens mitt) 1 min HF 61 SPM

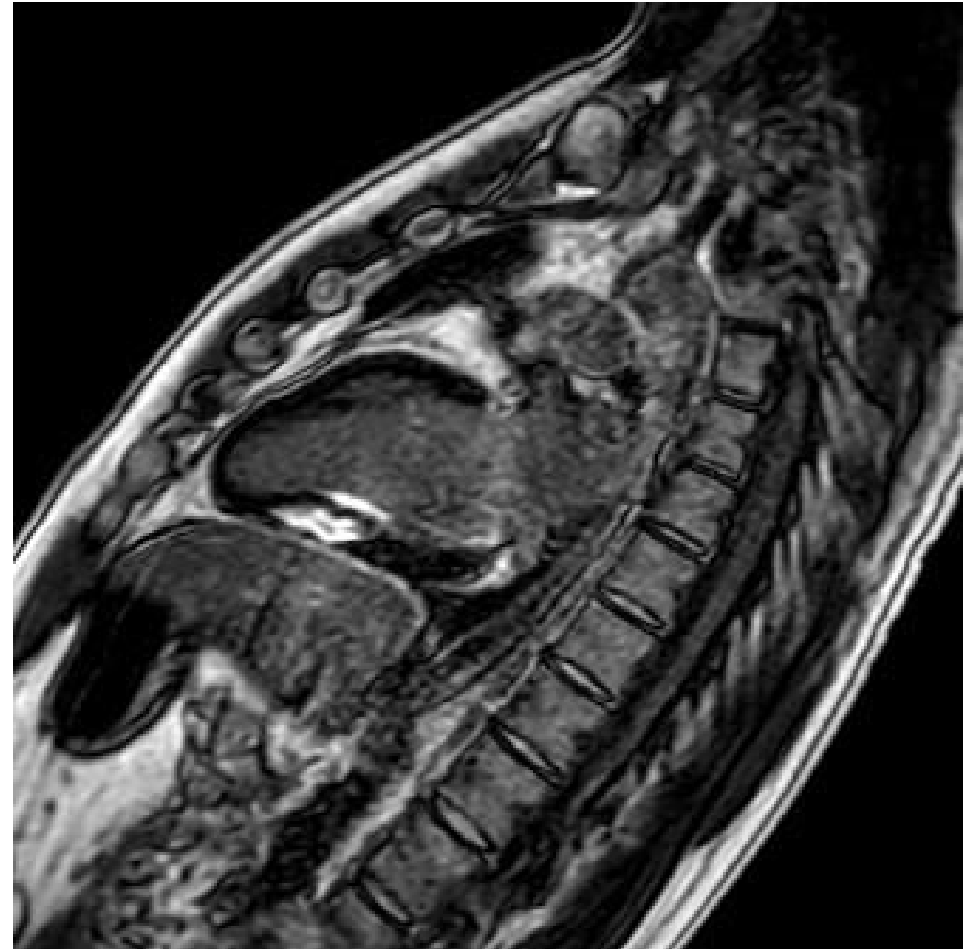
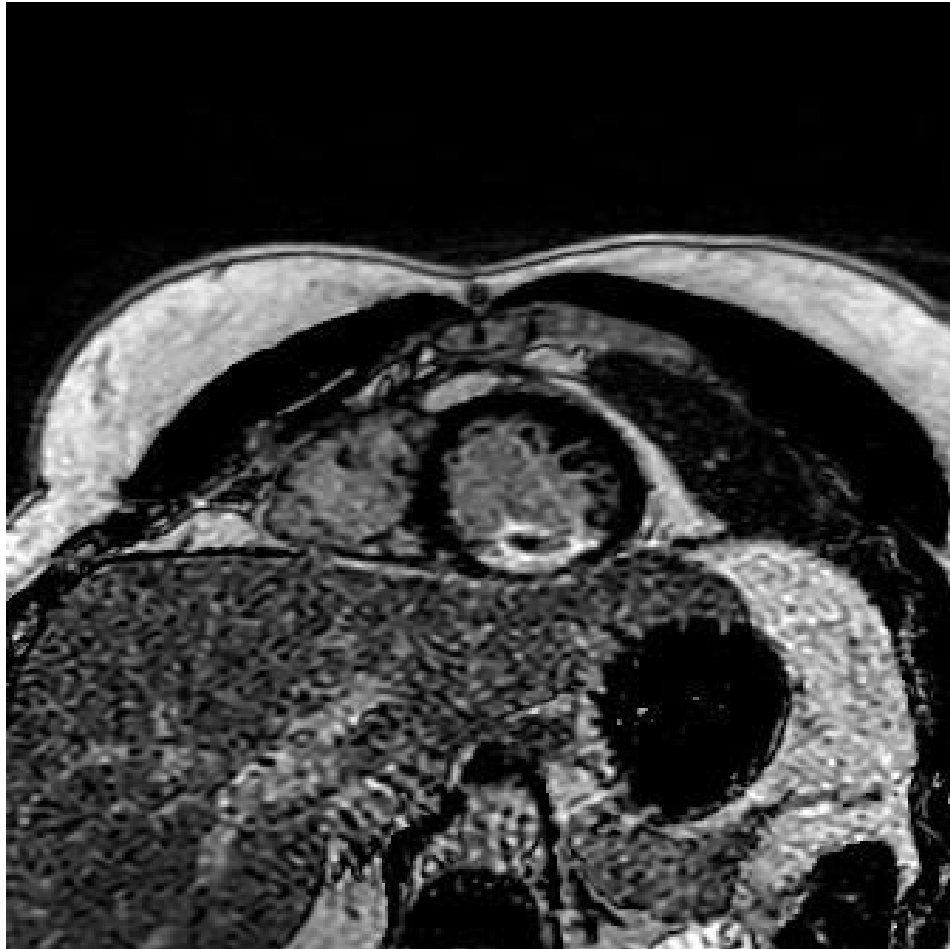
25 mm/s (Skala: 1:2)



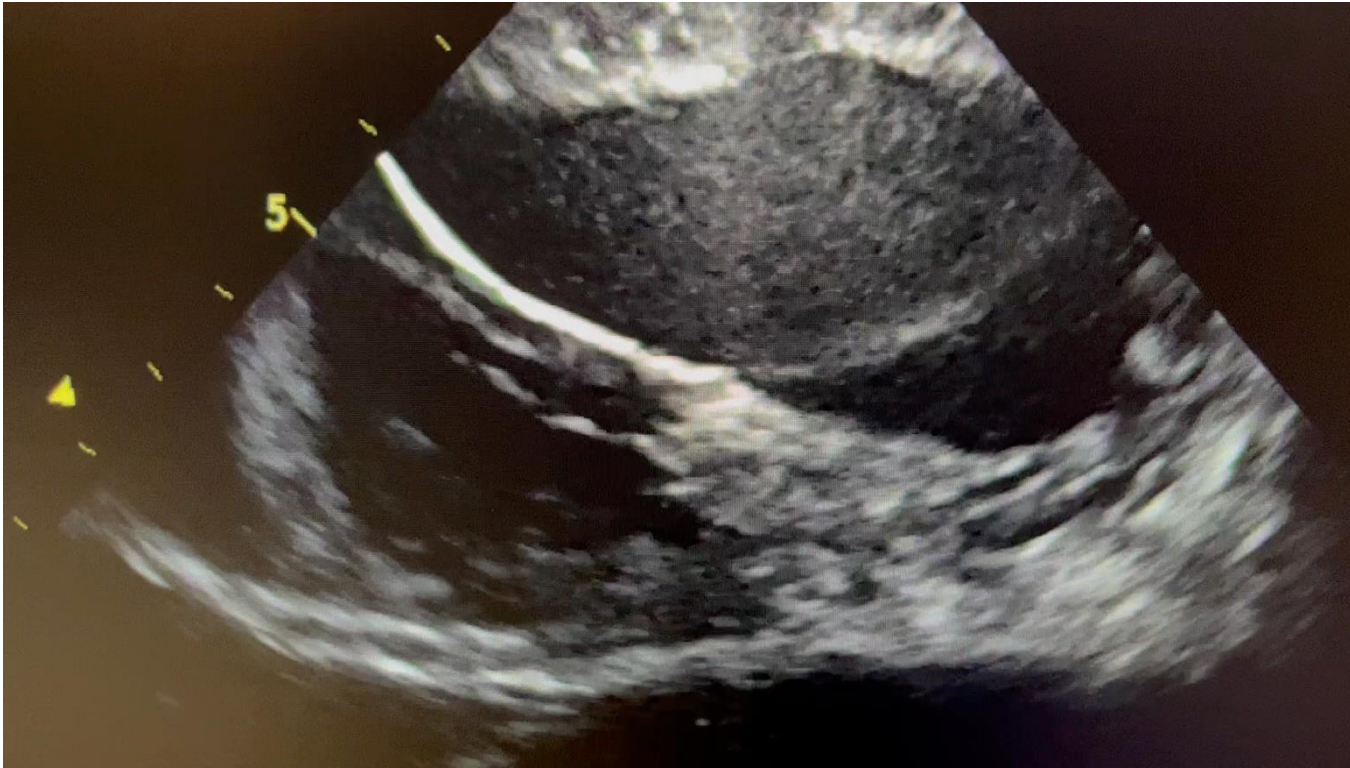
Kartläggning med 3D ultraljud



MRI innan ablation



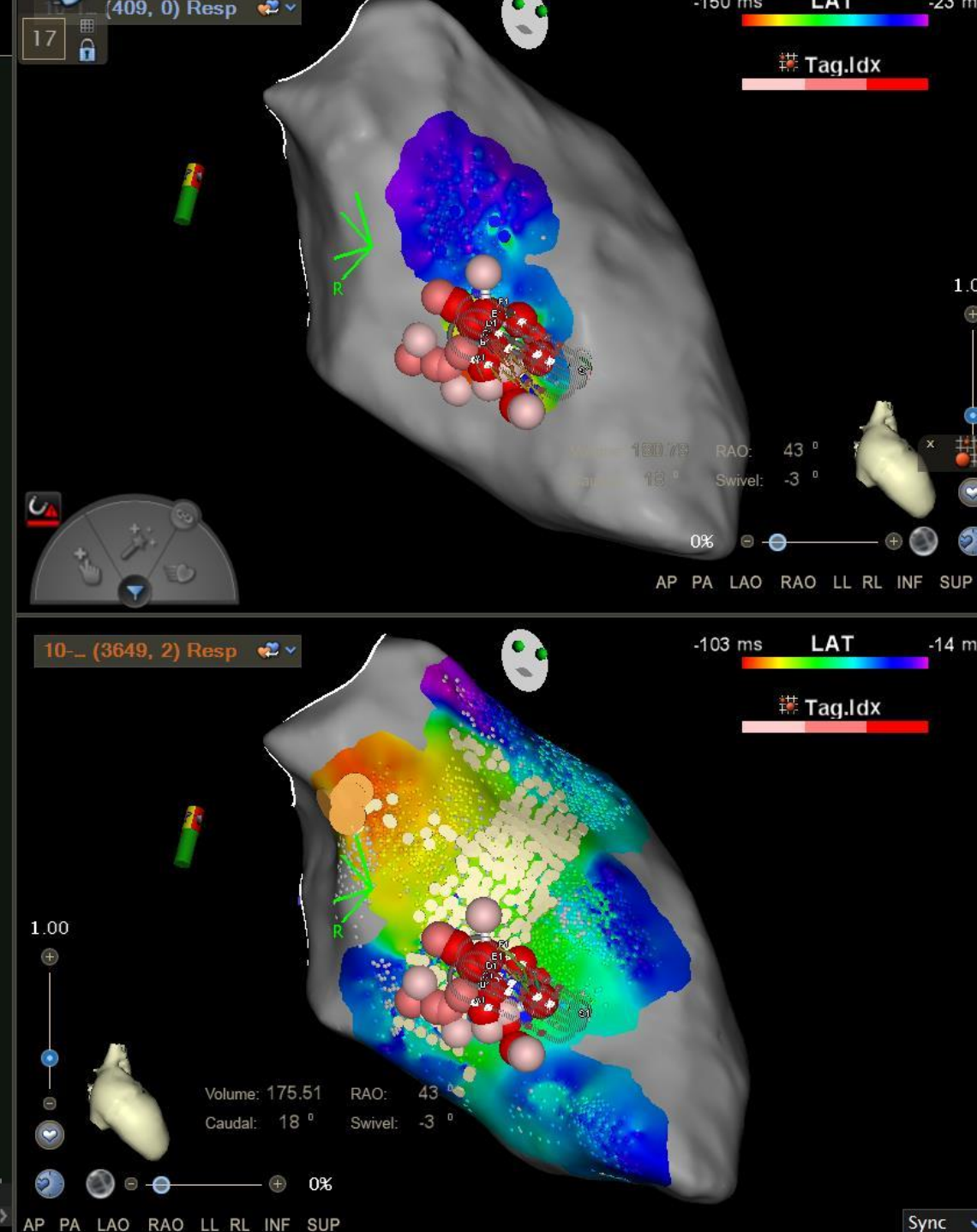
Cryoablation som hjälper till stabiliteten



Fascicular VT ablation

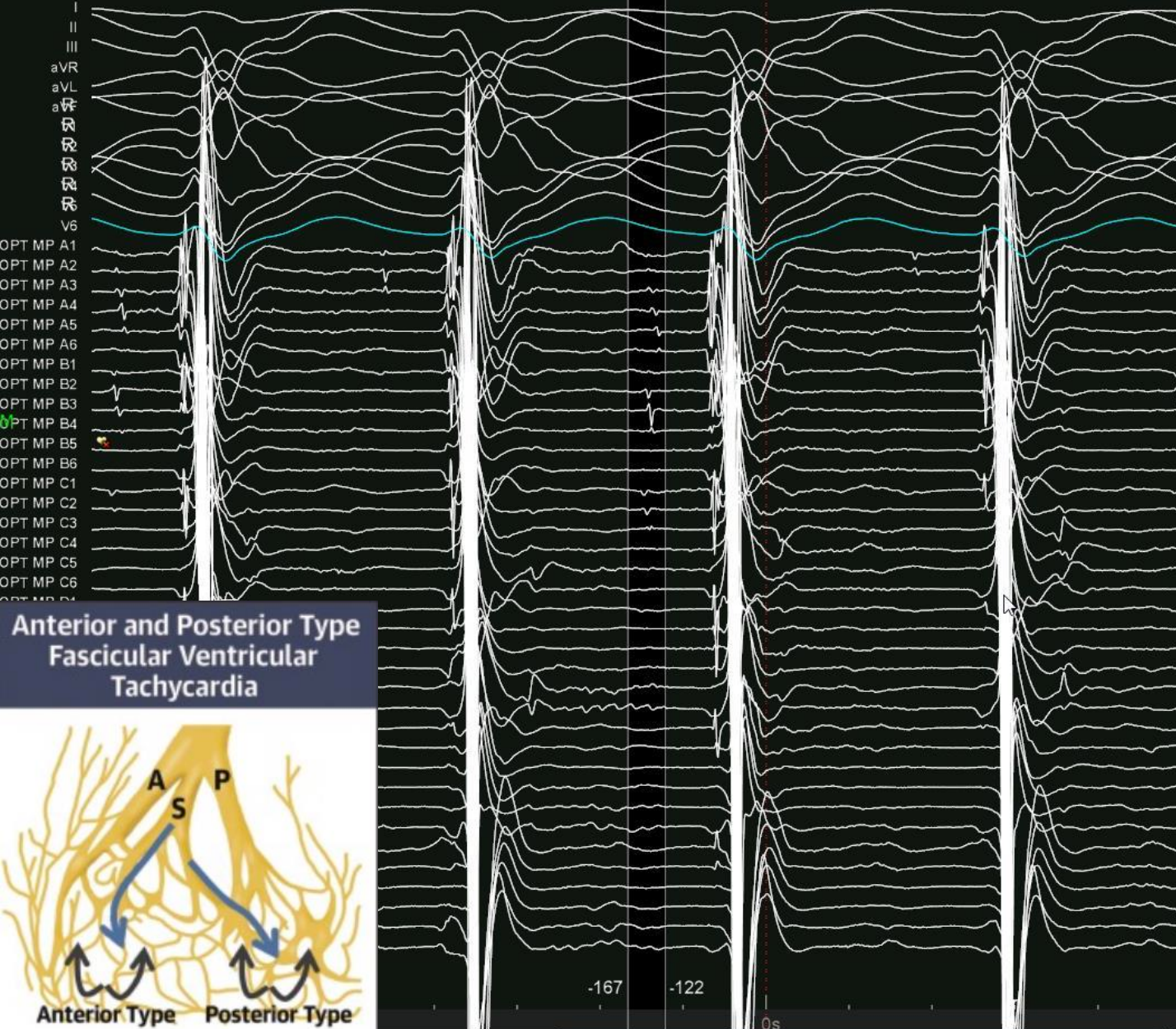


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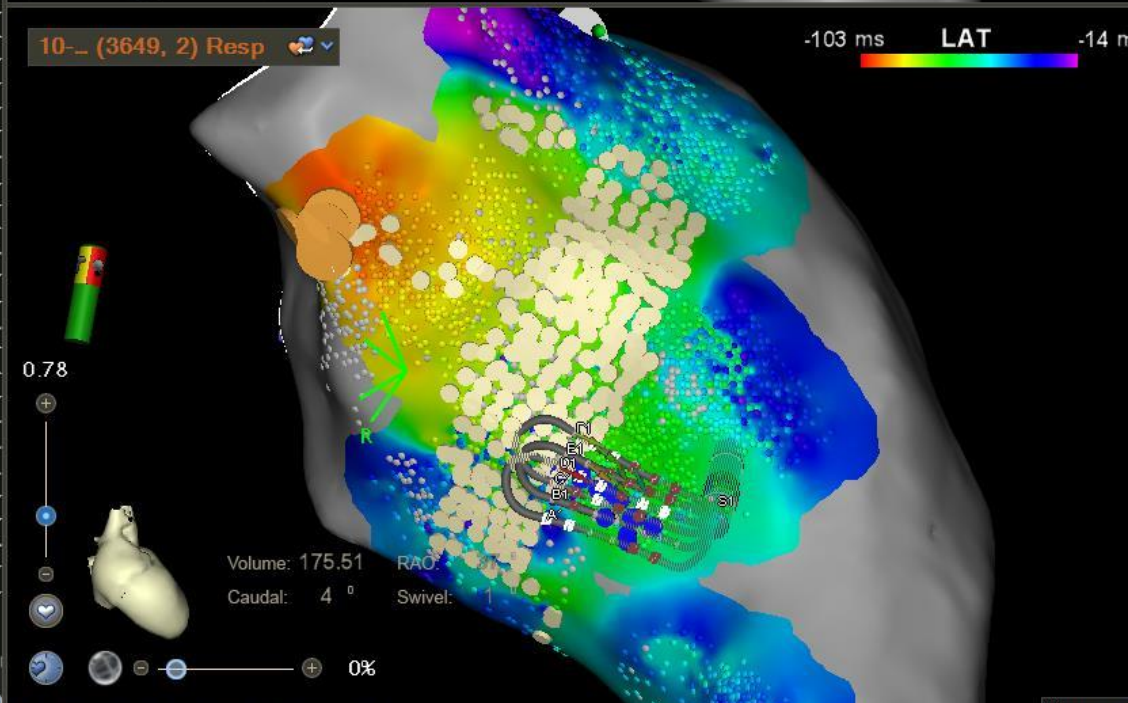
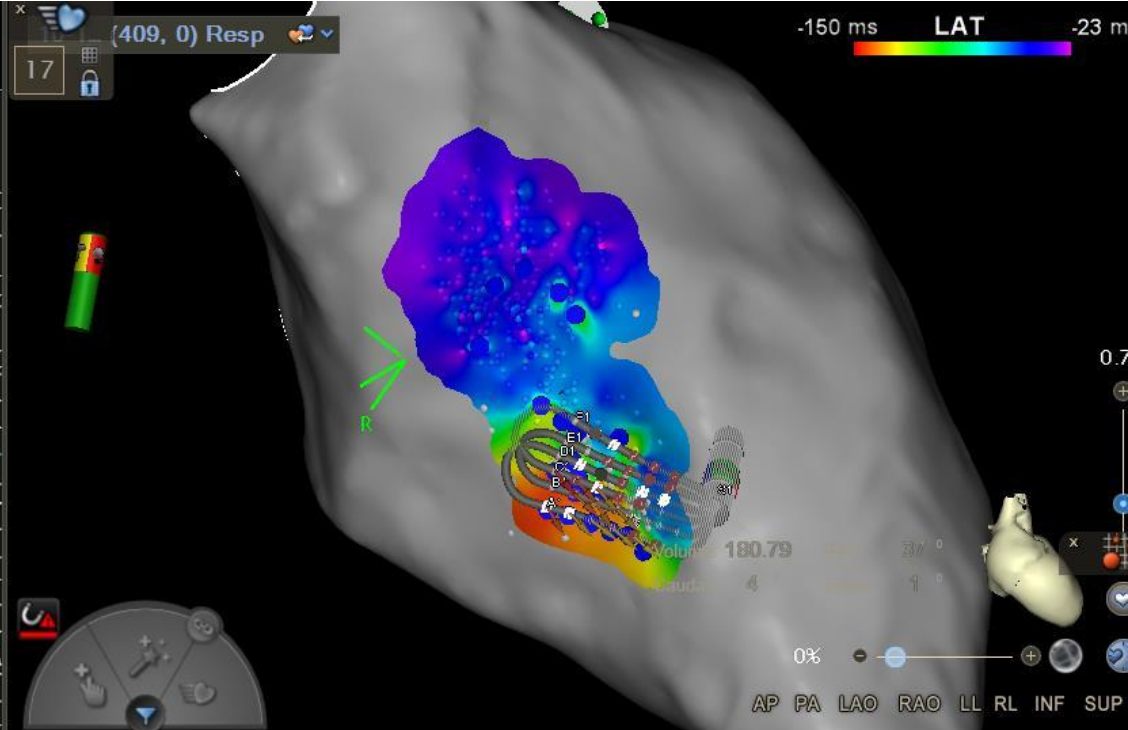
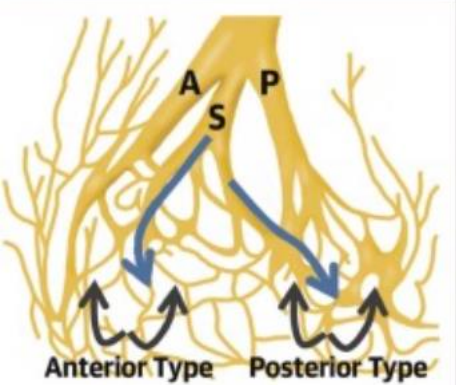


319 N/A Loc 0.51 N/A N/A N/A N/A
CL LAT (ms) Bi(MP) (mV) μ Bi (mV) Imp (Ω) Force (g) Complex (ms)

200 mm/sec



Anterior and Posterior Type Fascicular Ventricular Tachycardia

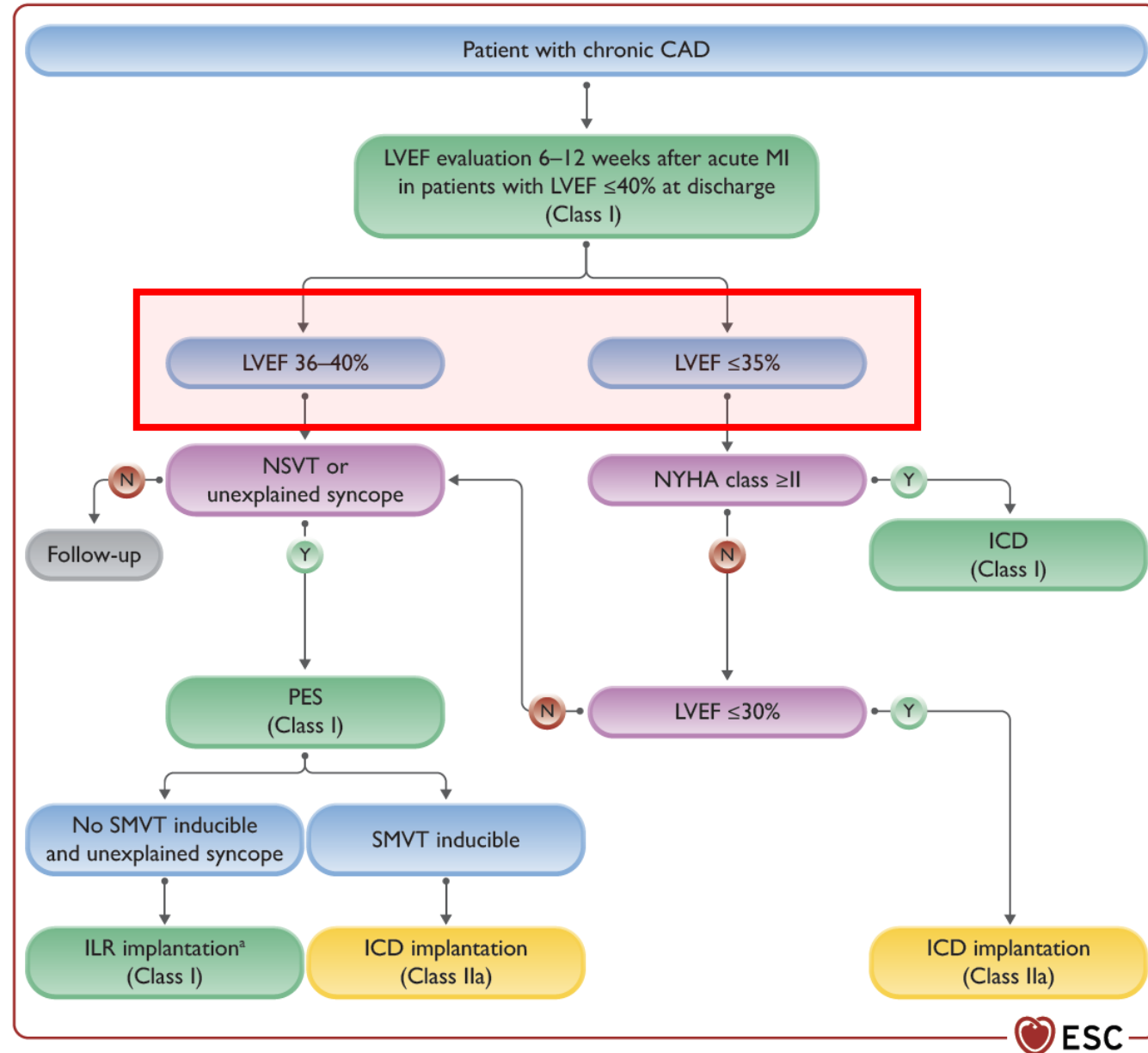


VT ablation i strukturella hjärtsjukdomar



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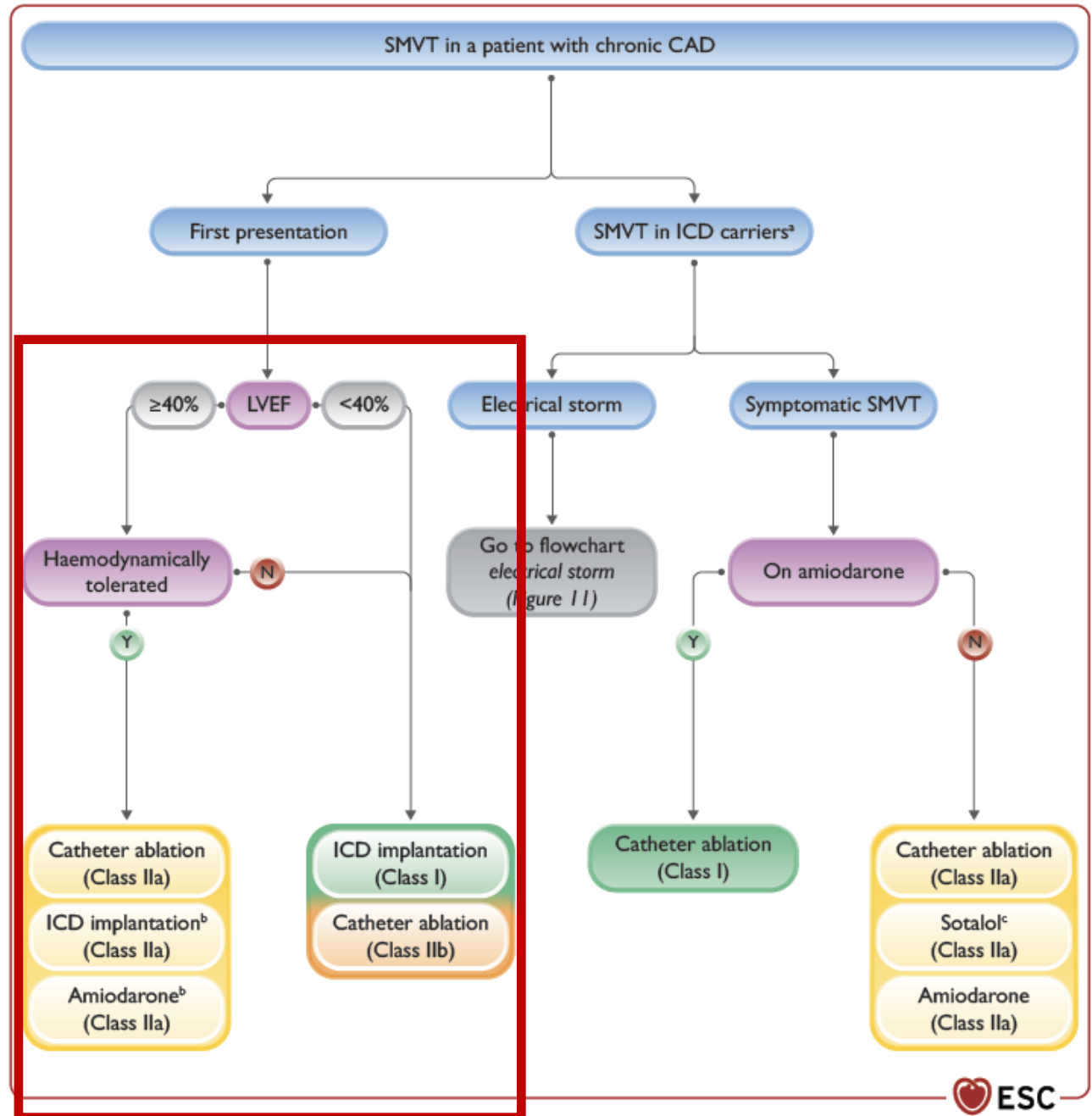
Algorithm



Algorithm for SMVT in chronic CAD

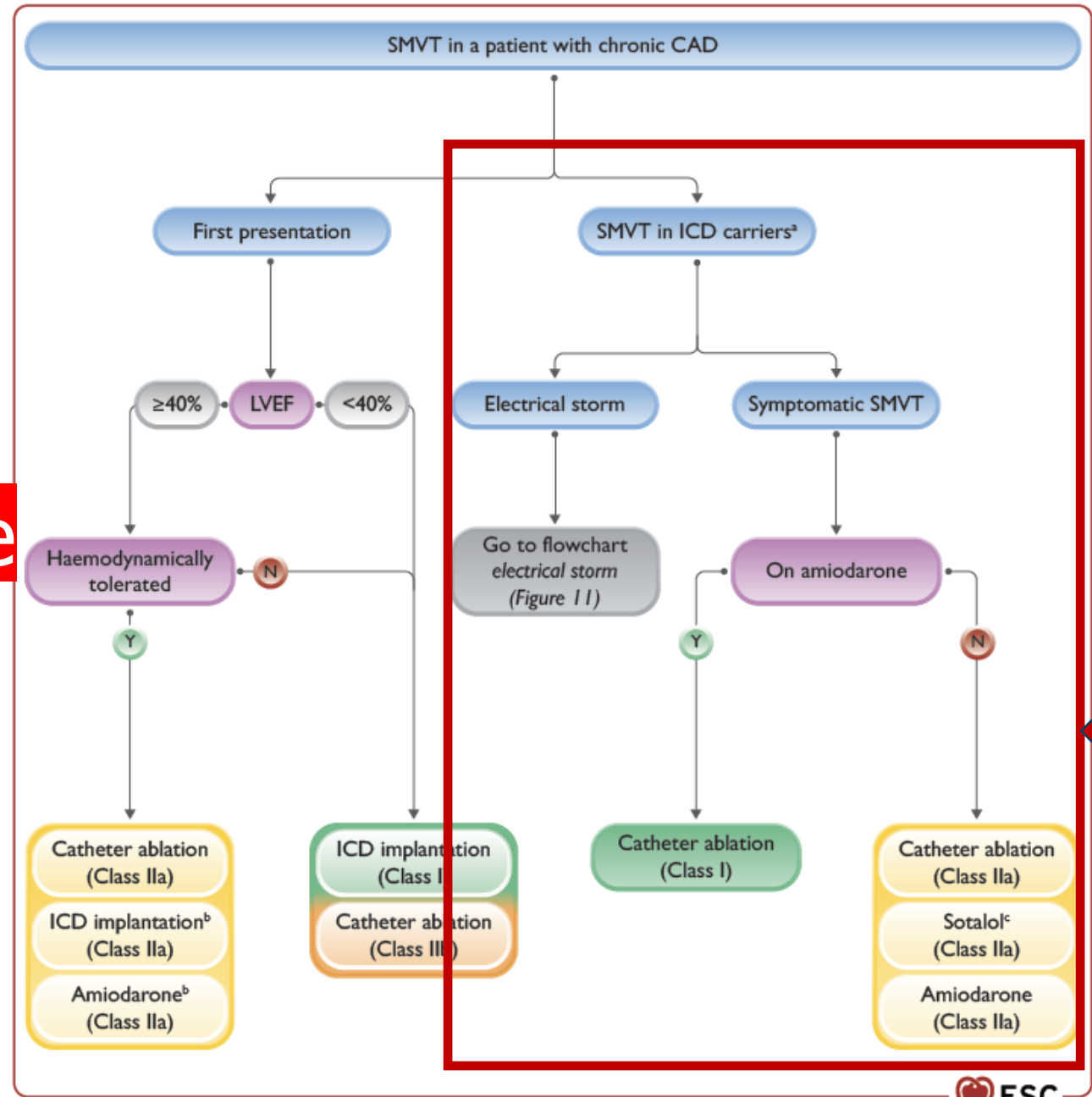
Förstagångs VT

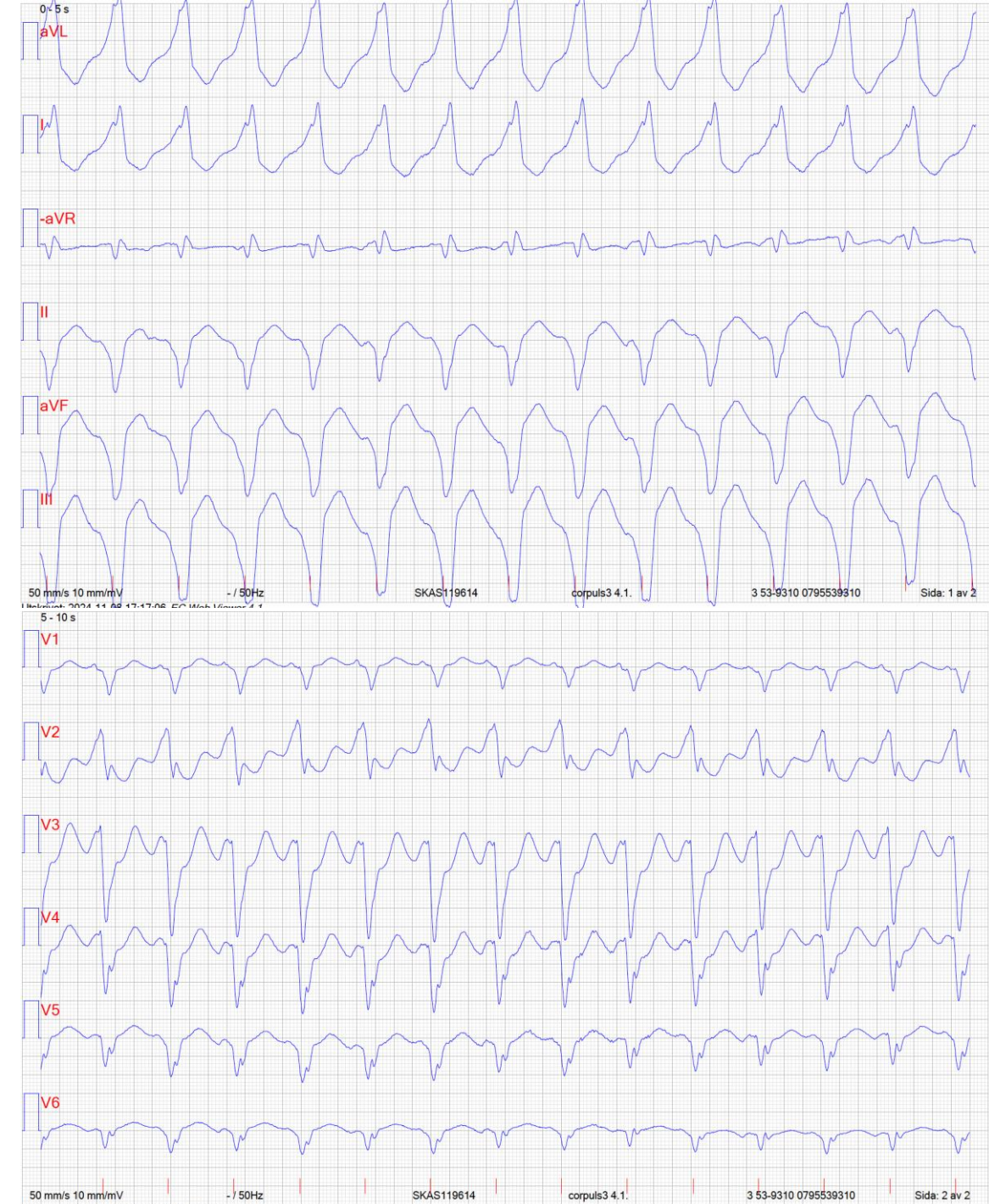
ICD only if ablation not possible or not successful



Algoritm för SMVT i kronisk CAD

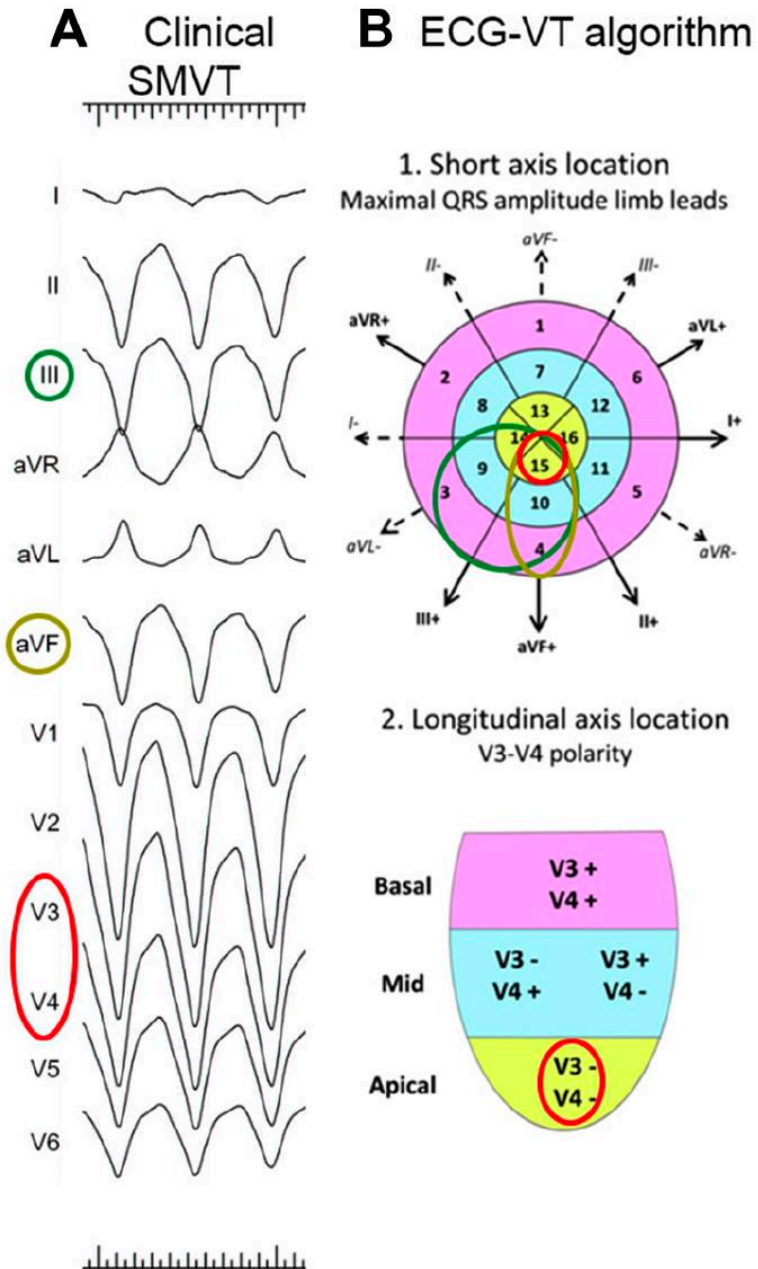
hos ICD bärare



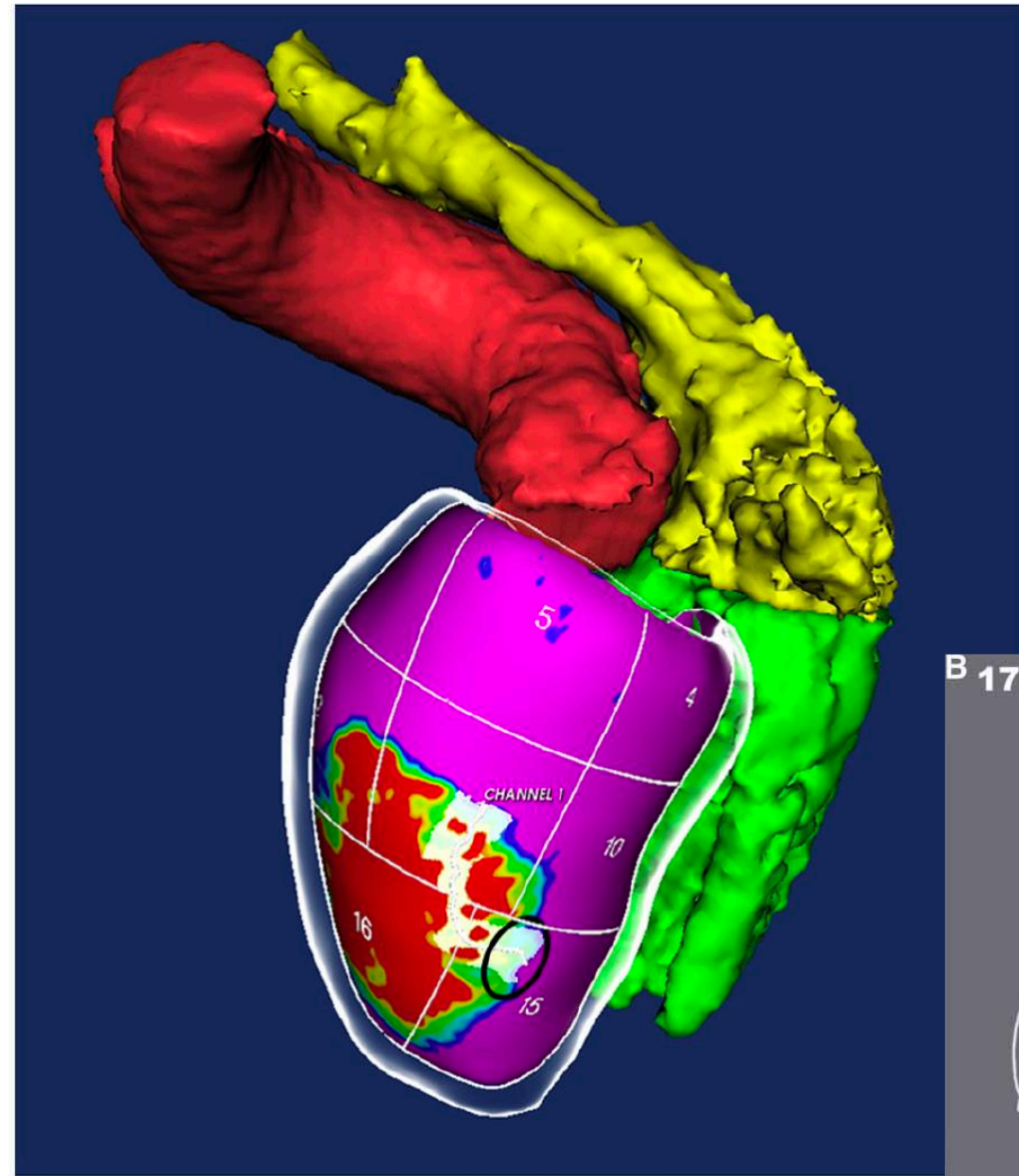


Dokumenterad 12 avl EKG
under VT (170/min)

FIGURE 3 Example of a Tolerated, Clinical SMVT Ablation

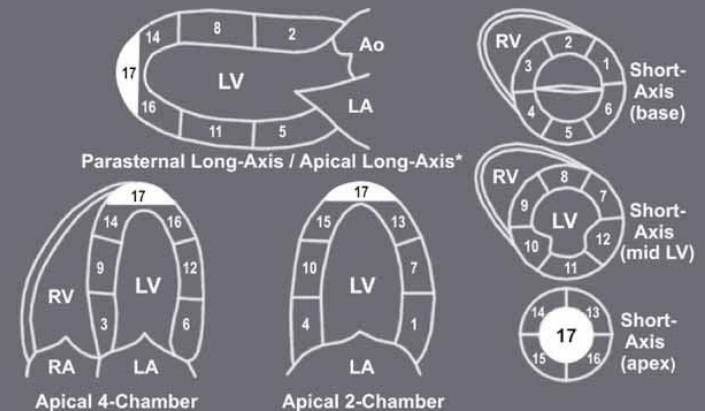


C LGE-CMR (Endocardial PSI & HTC)

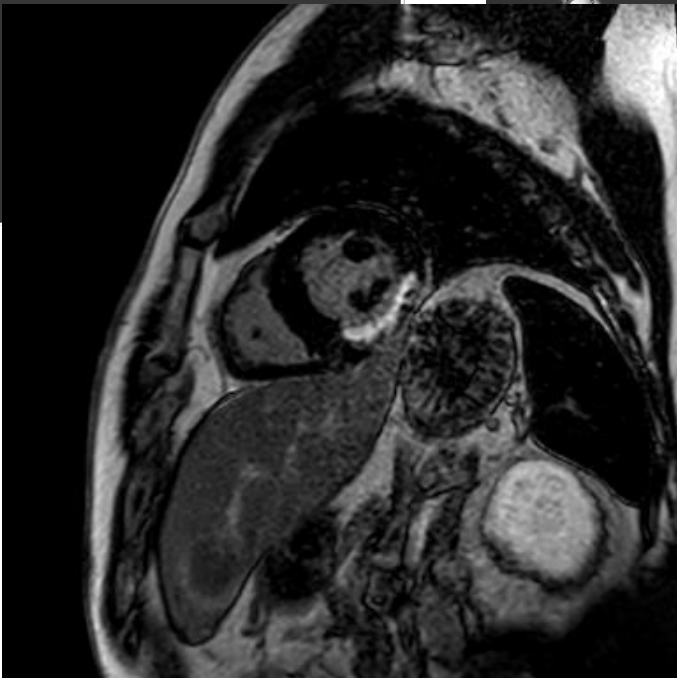
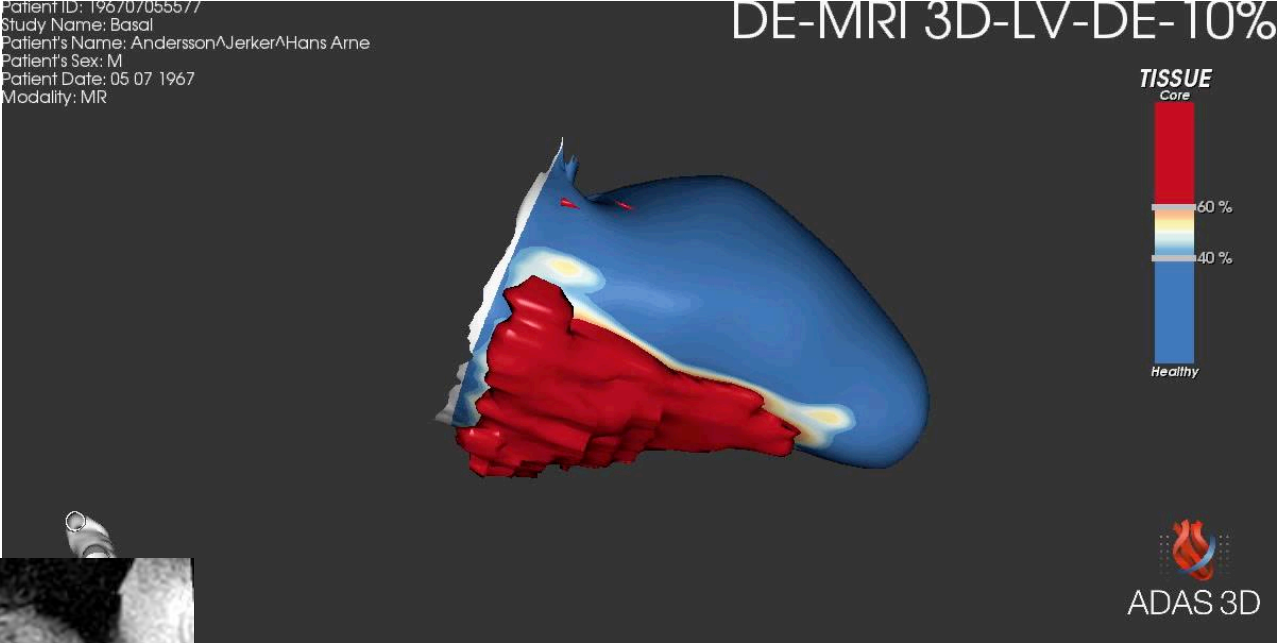
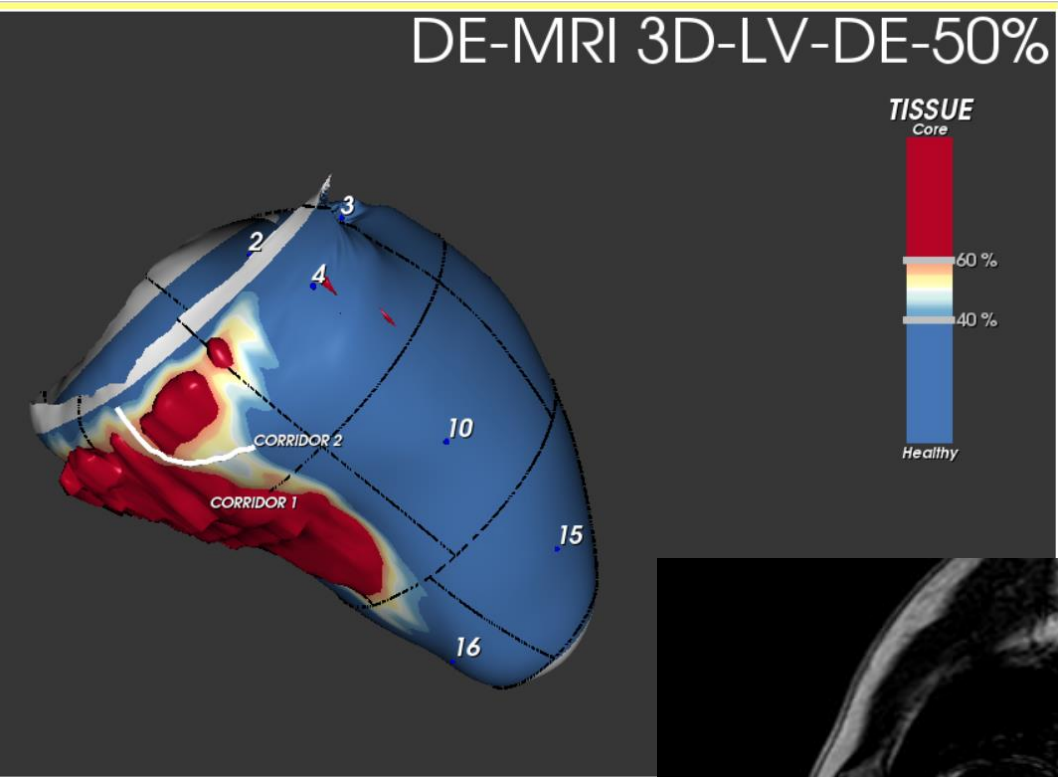


EKG guided
ablation

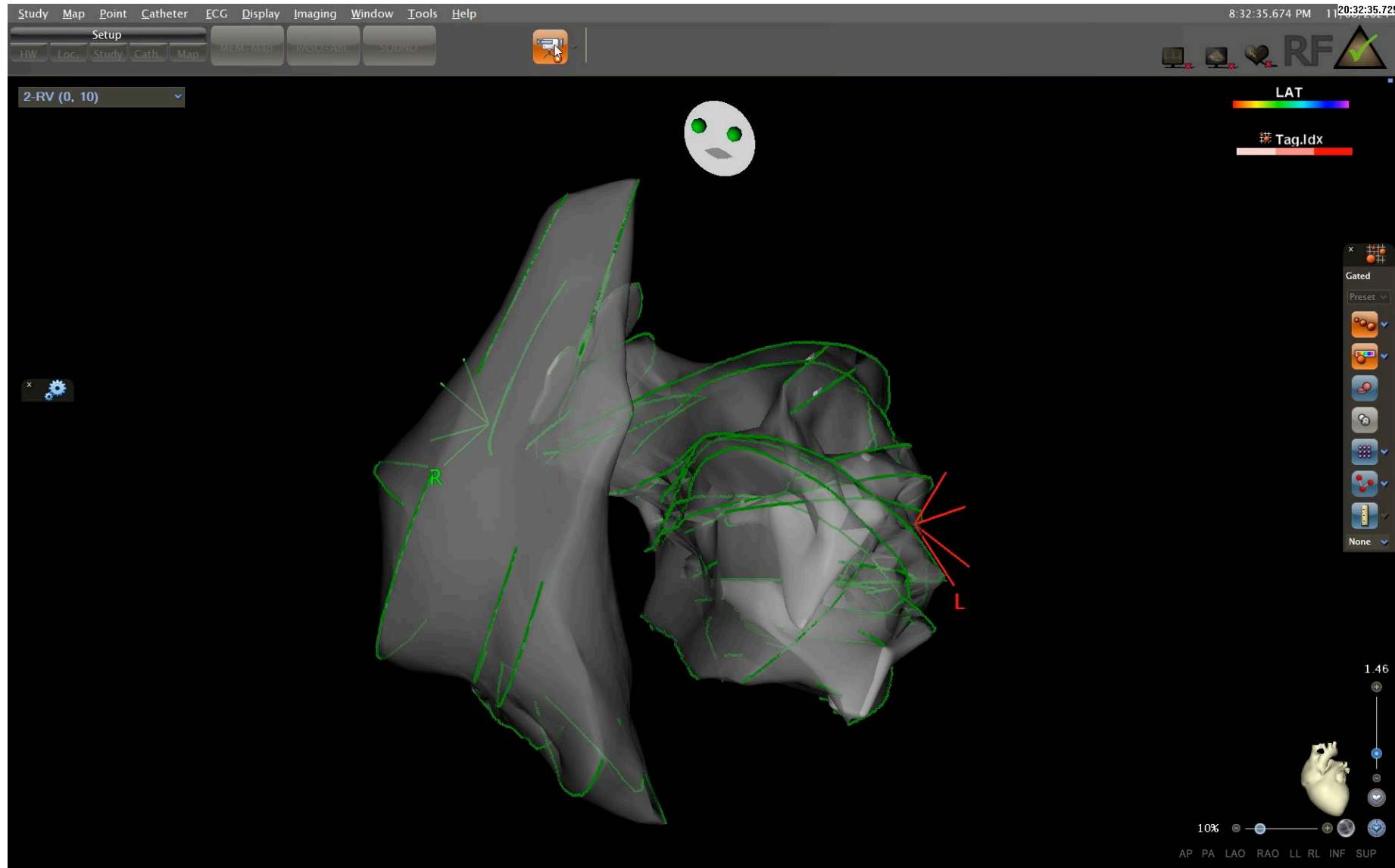
B 17-Segment Left Ventricle Model (AHA)



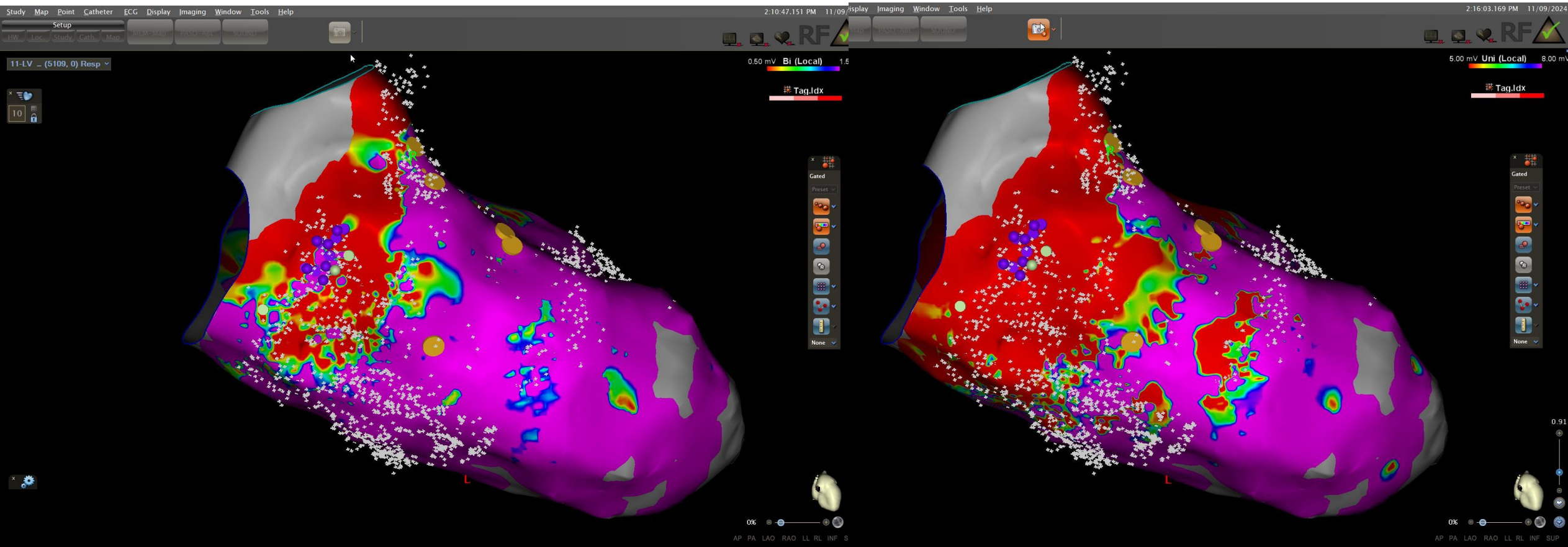
Efterbearbetning av MRI (2022) bilder



3D rekonstruktion av anatomi med CartoSound teknik



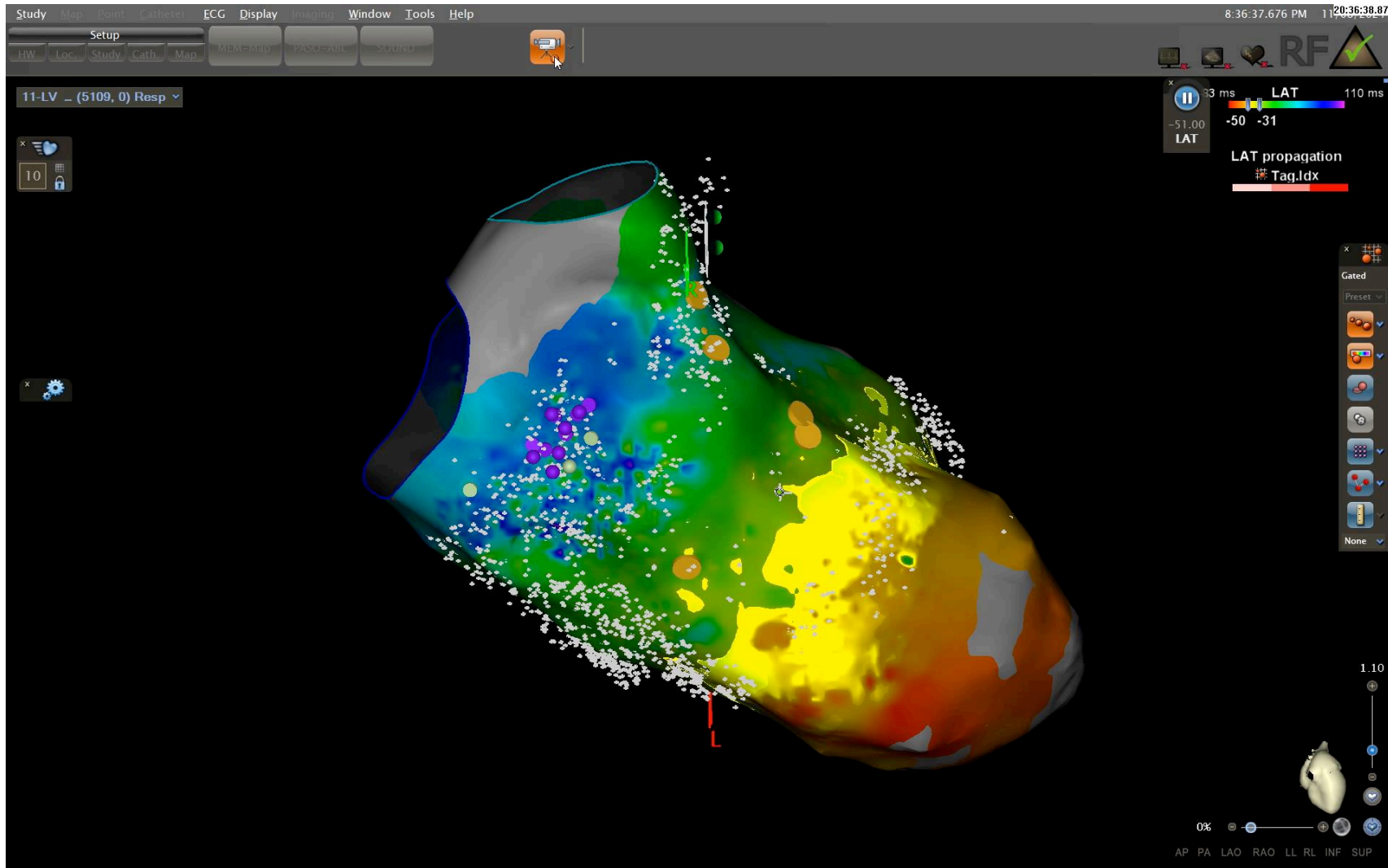
Kartläggning i sinus rytm, voltage map



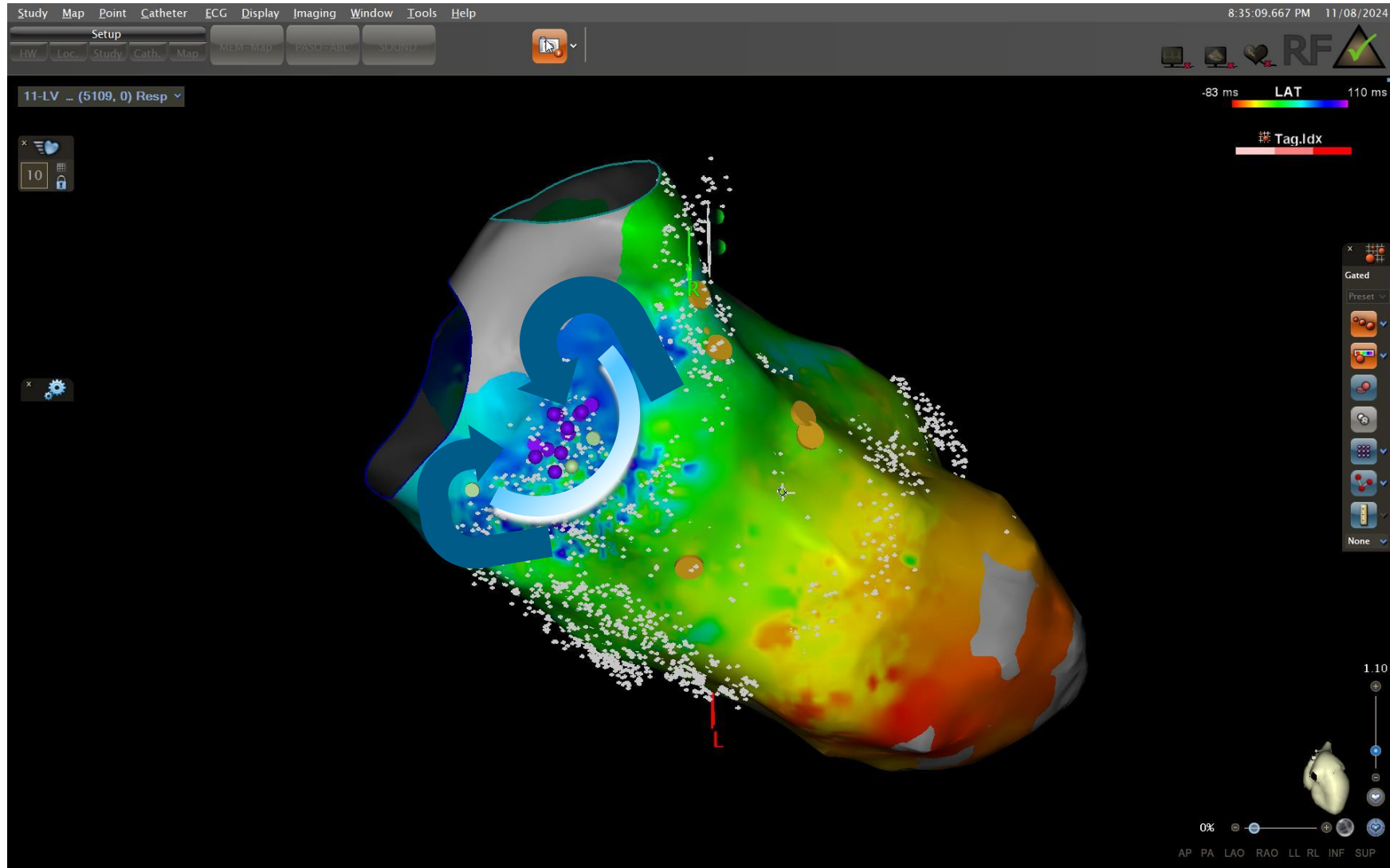
Bipolar

Unipolar

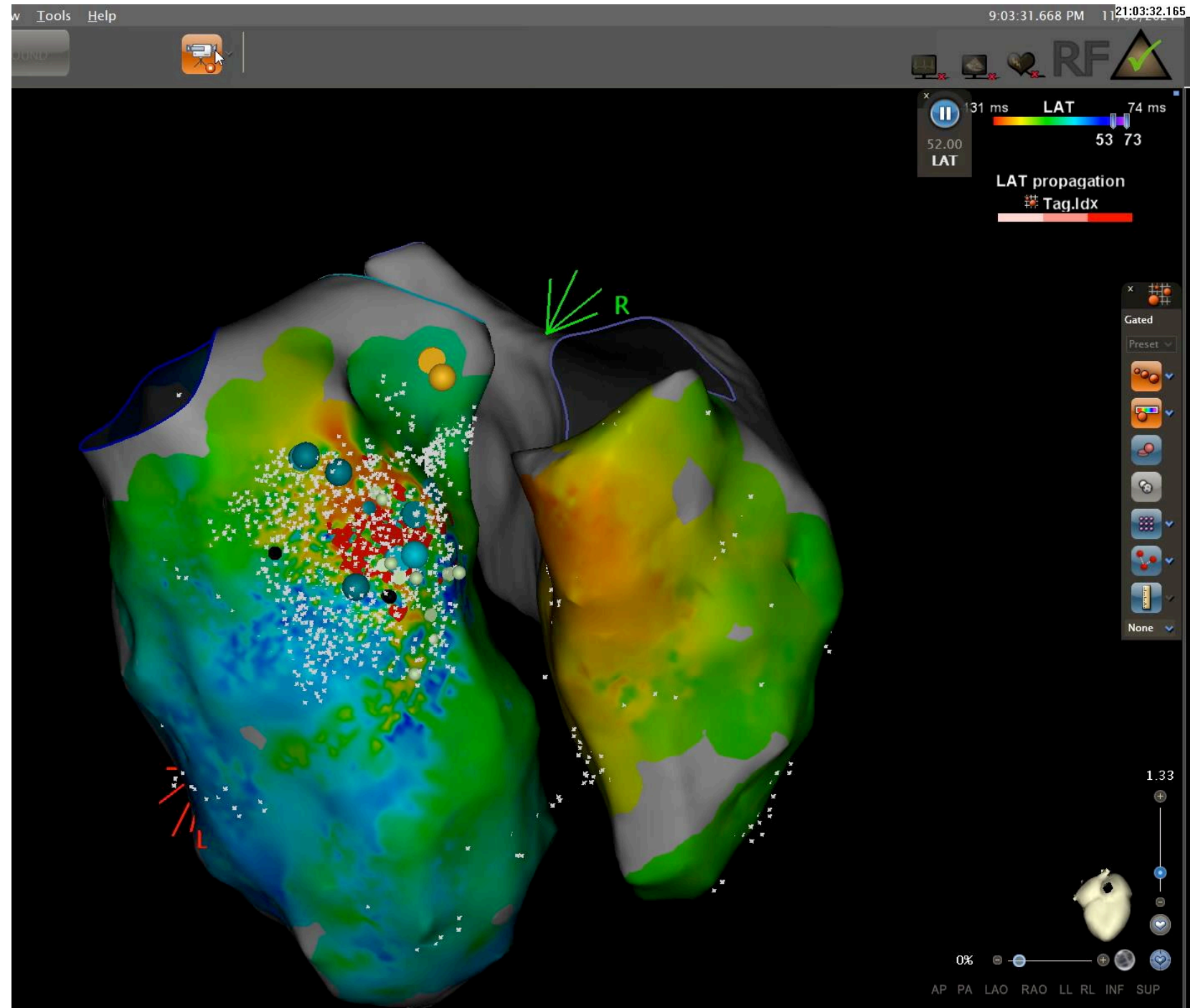
Kartläggning under RV stimulering



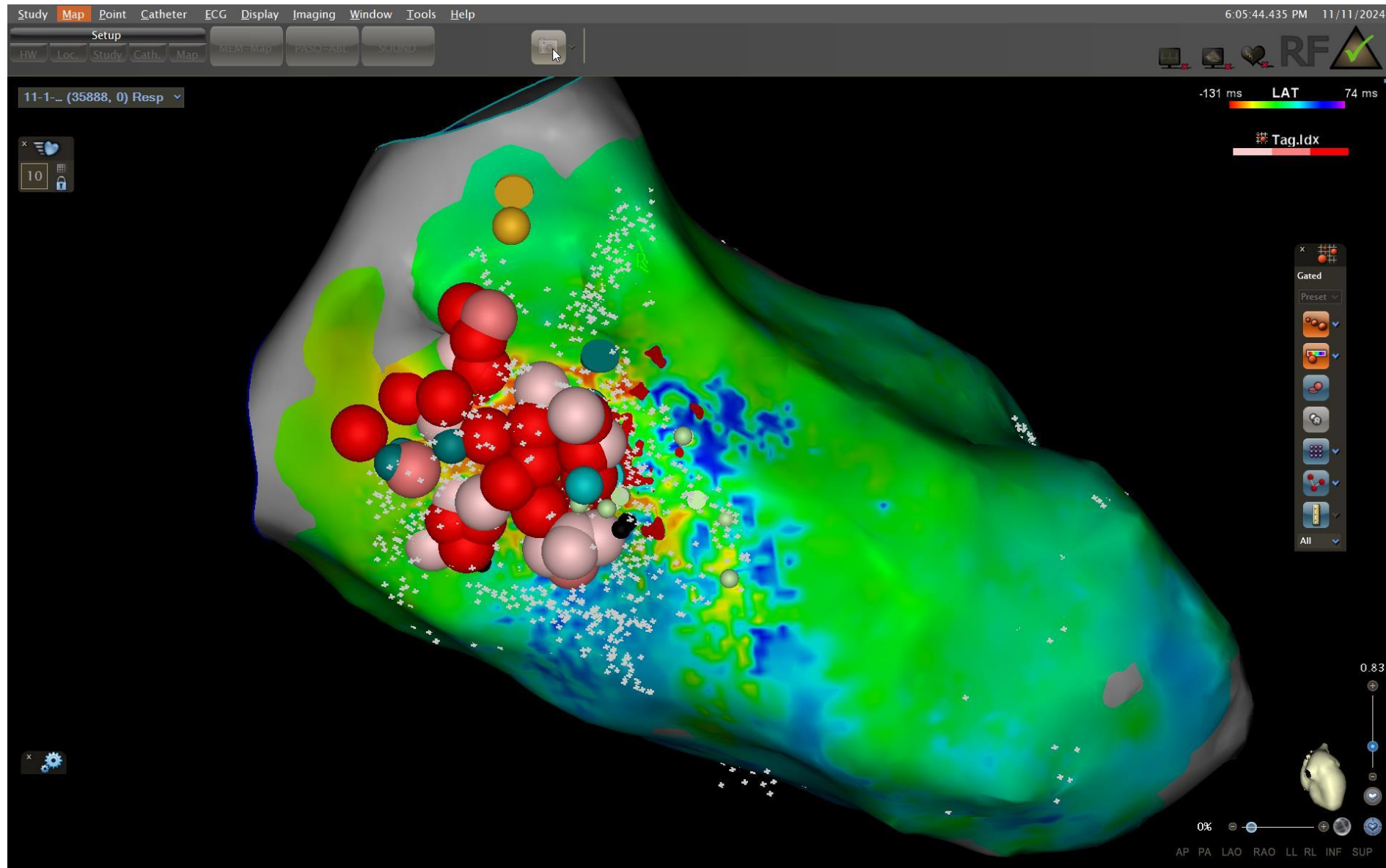
Line of block (LOB)



Biventricular map under VT



Ablation



Mapping är ändå begränsad p g a 3D aktivering

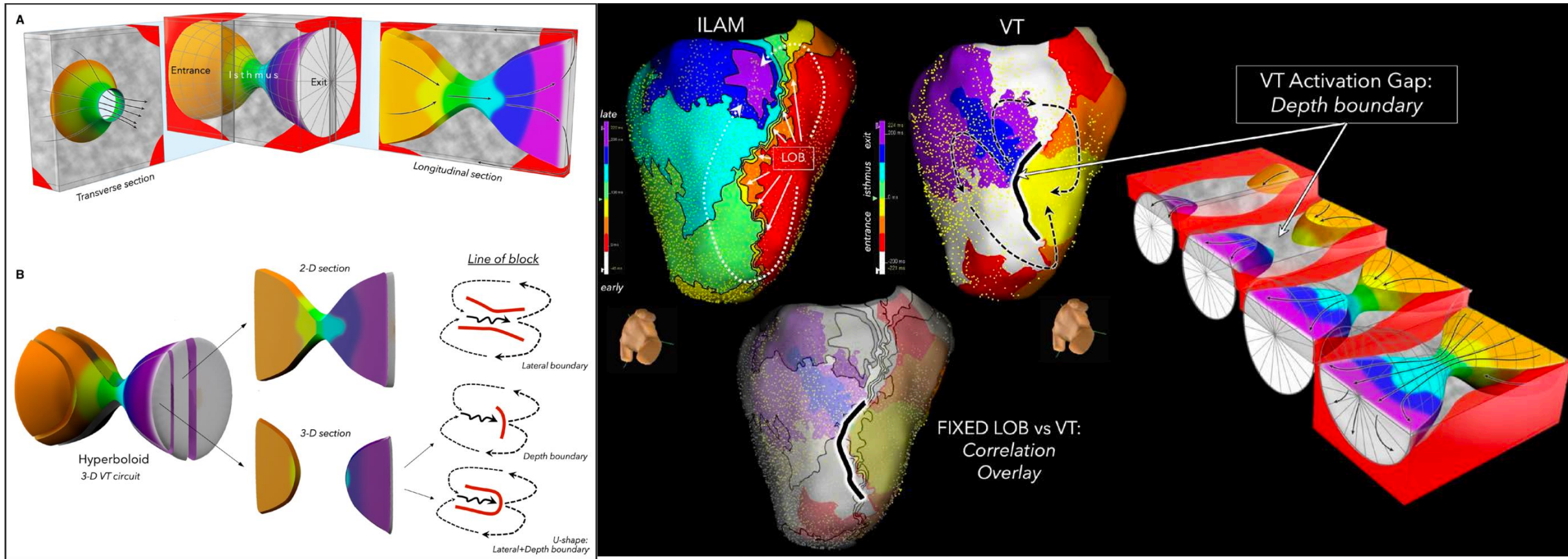


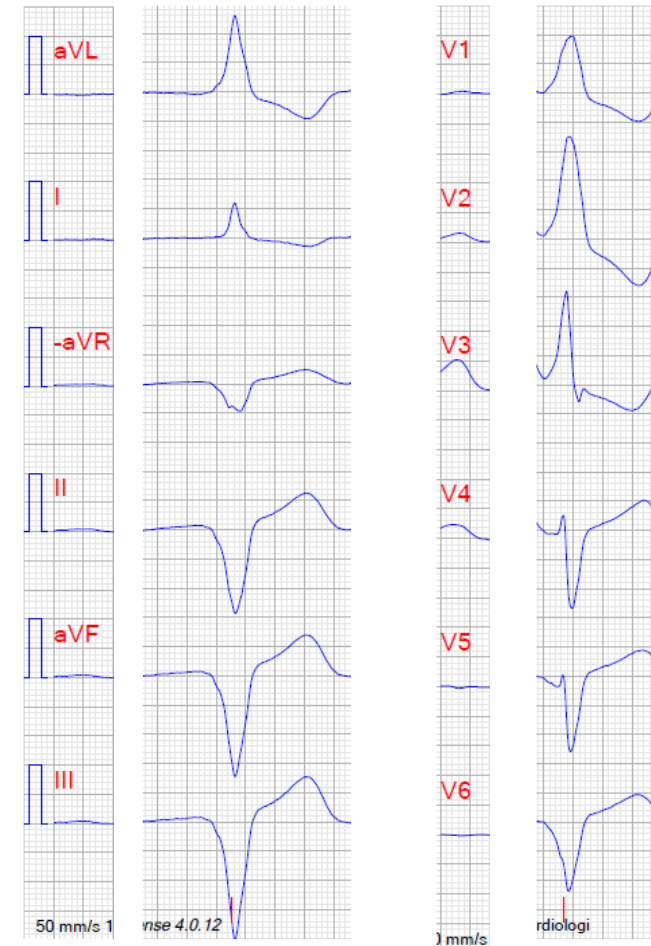
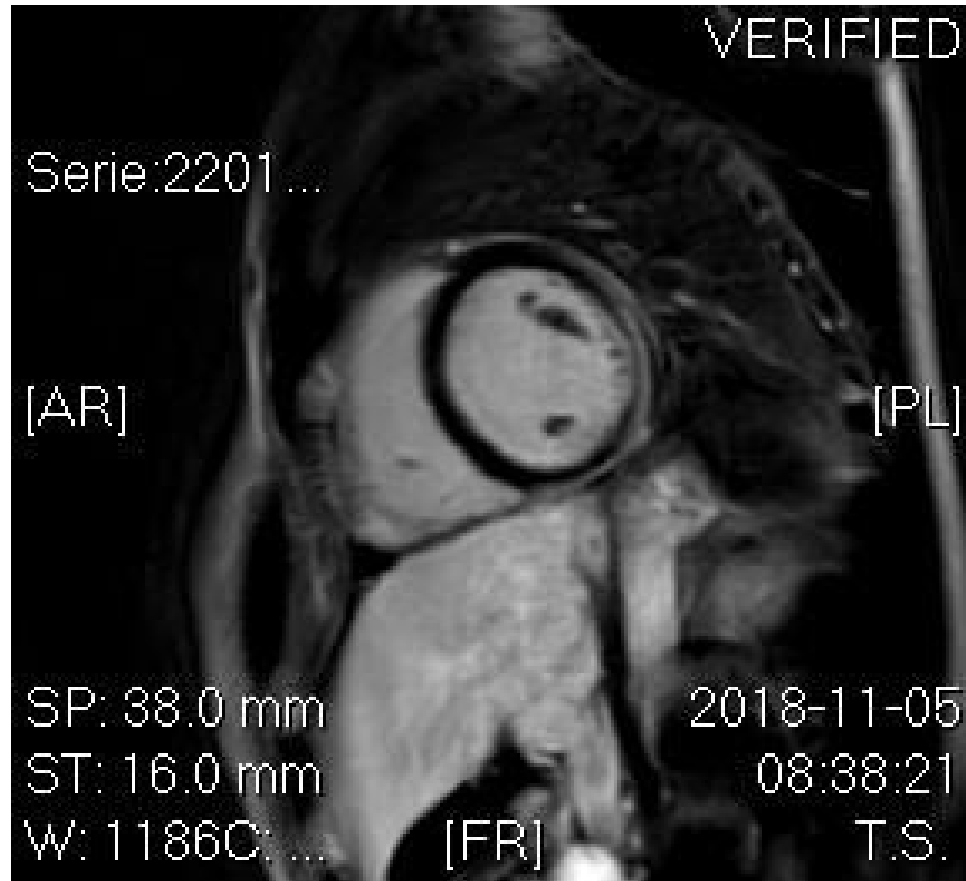
Figure 1. A hyperboloid model of the three-dimensional ventricular tachycardia circuit.

Epicardial VT ablation



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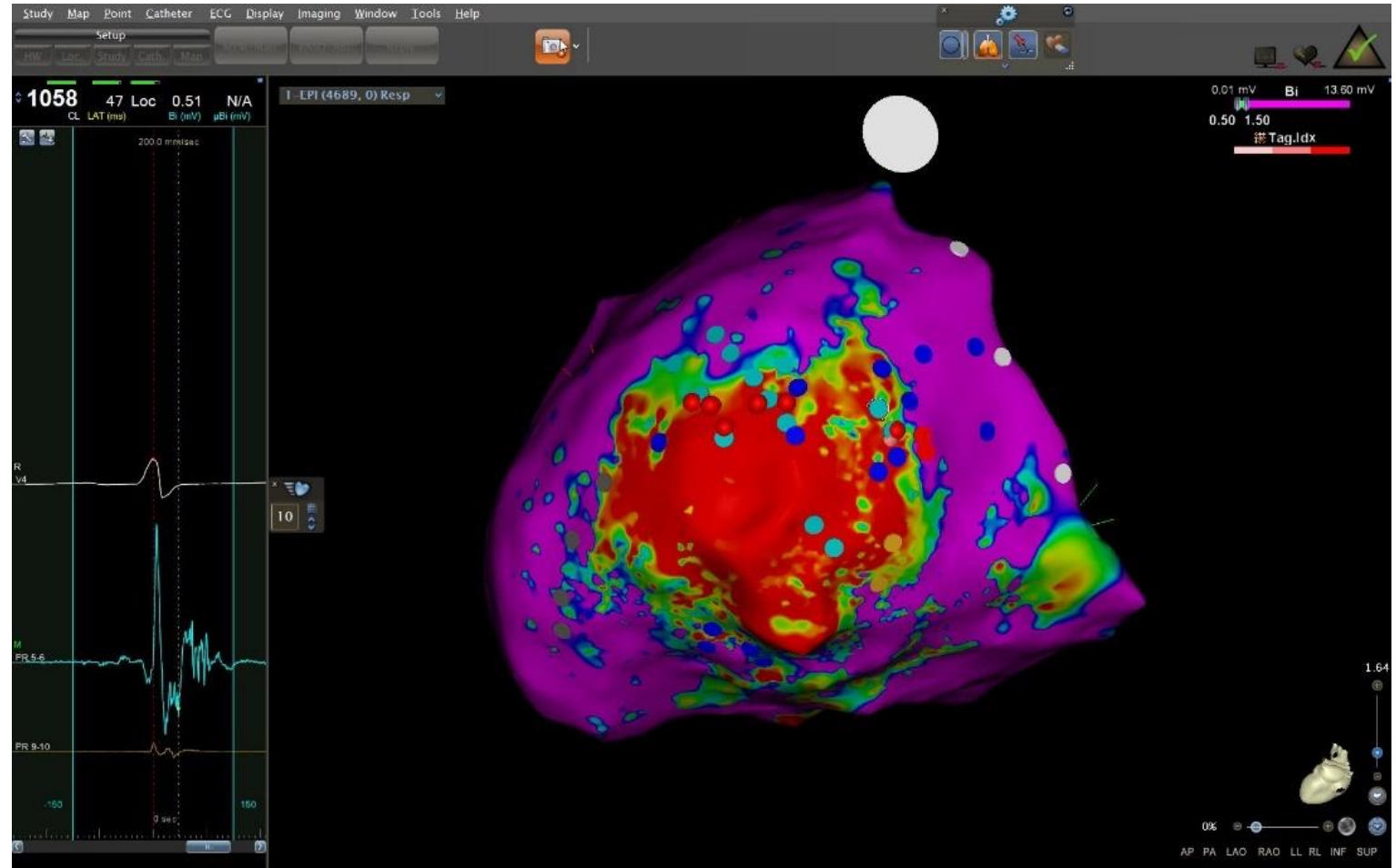
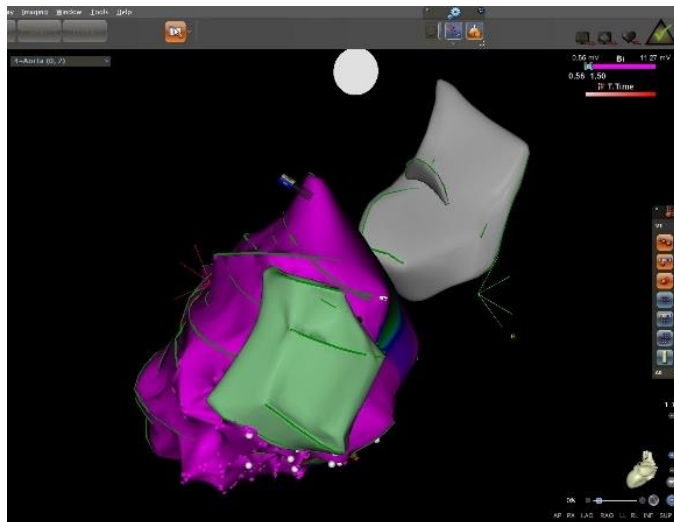
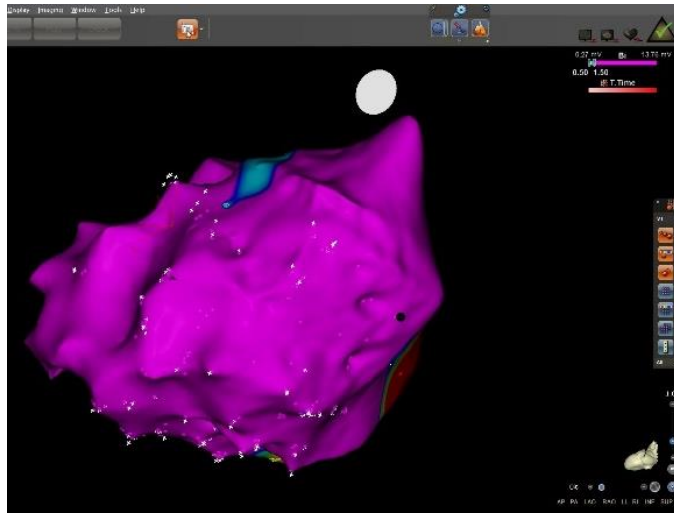
Preablation och pre ICD implantation ceMRI and ECG



Perimyokardit

Endokardiell mapping, ingen ärrbildning

Epikardiell mapping, ärrbildning med kanaler



PTCA-lab SU/S

Aspirin

53

31-October-17

7:55:06



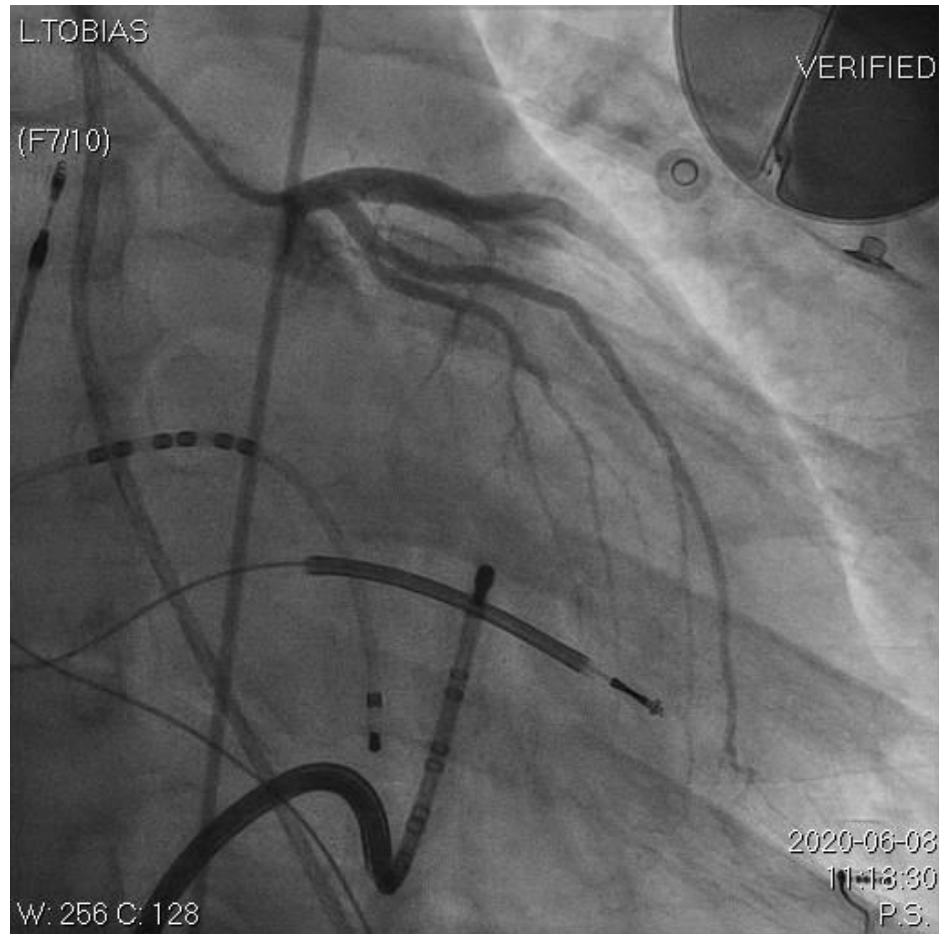
L: 112.00

W: 125.00

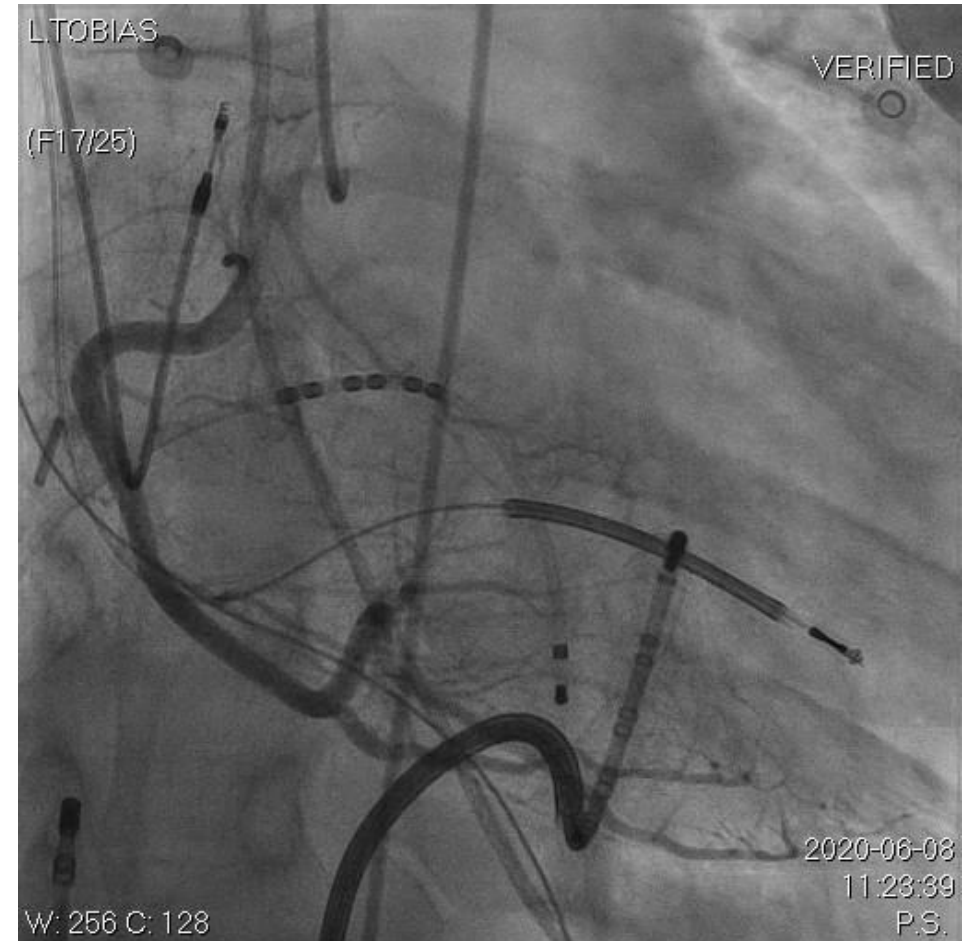
EL FYS

Coronariangio during epicardial VT ablation and pacemapping to avoid phrenicus injury

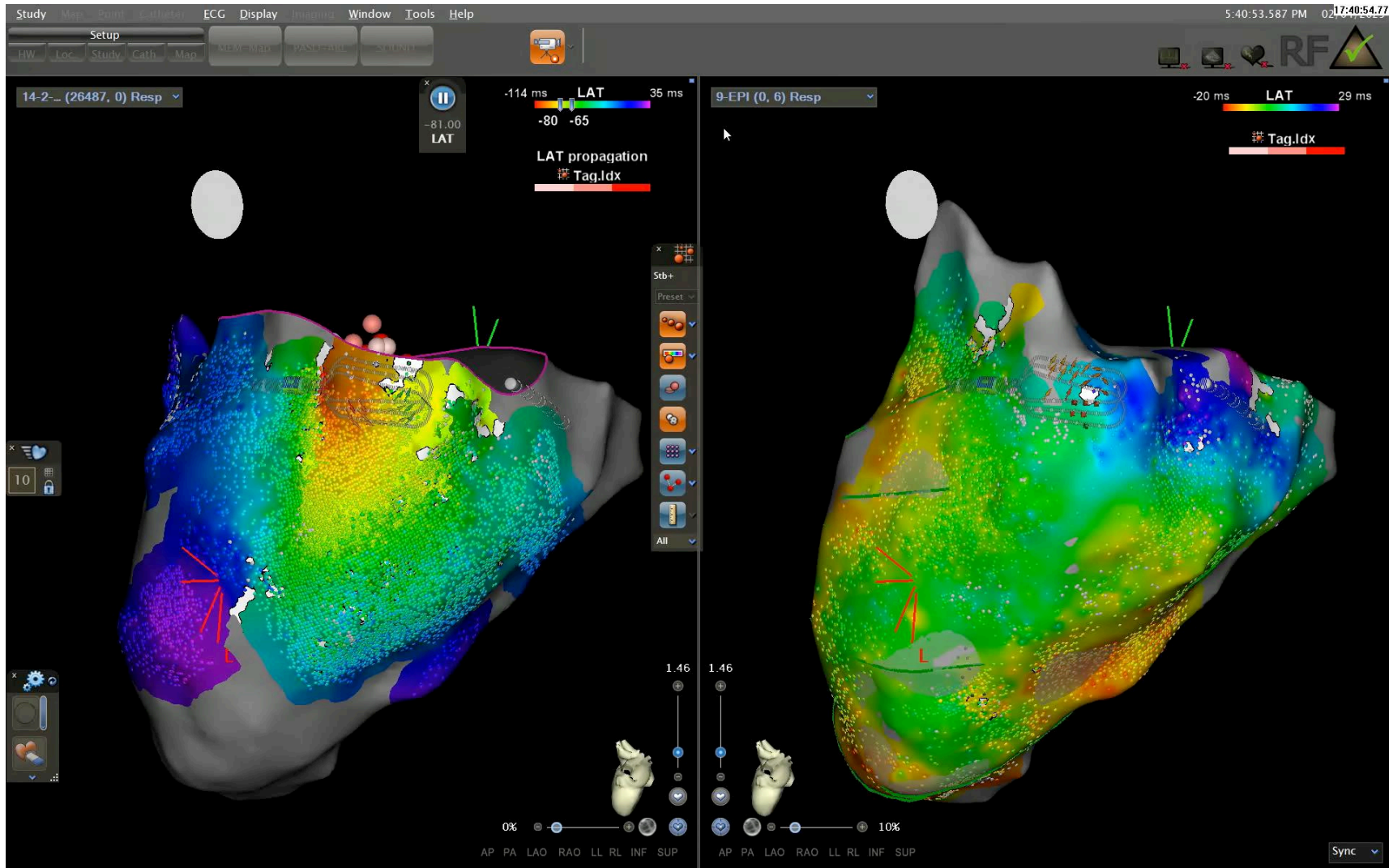
Vänster



Höger

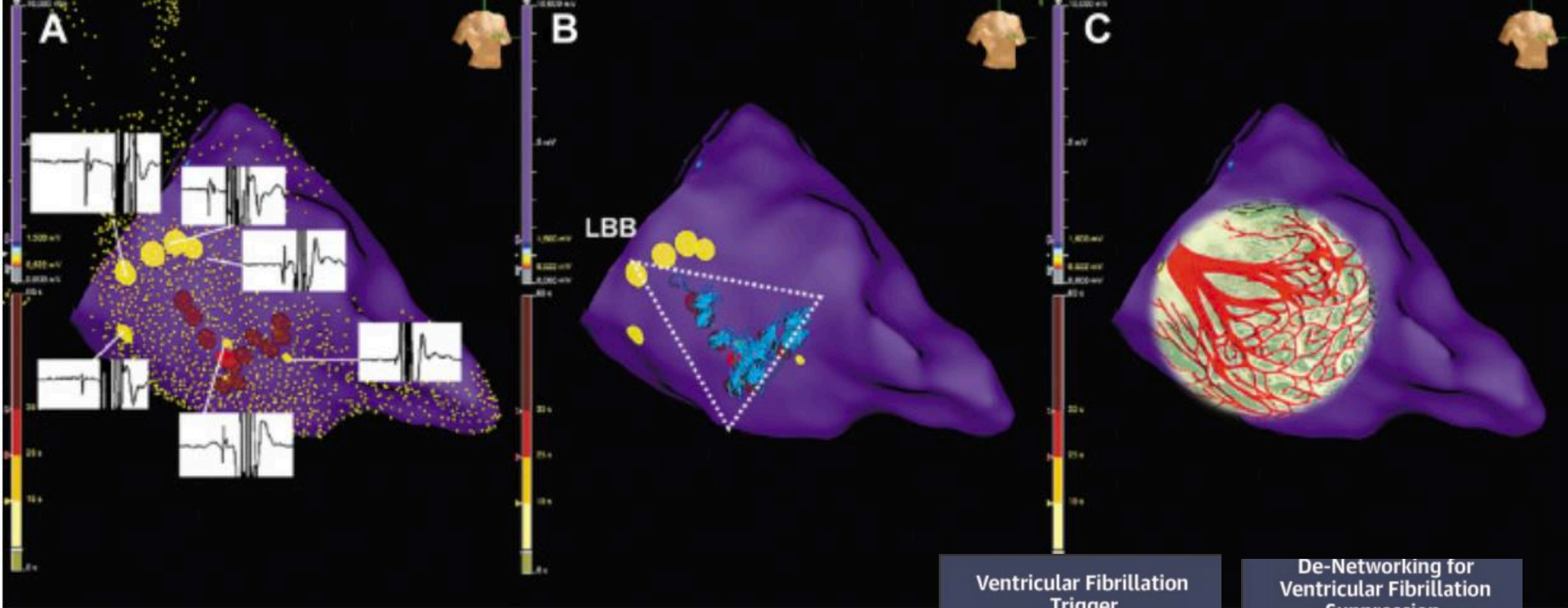


Epikardiell high density map under VT



Primär epikardiell ablation är planerad

- ARVC
- Postperimyokardit VT
- Om MR tyder på epikardiell substrat
- Brugada's syndrom och långt QT ablation



Purkinje denetworking vid
idiopatisk VF eller vid
elektrisk storm

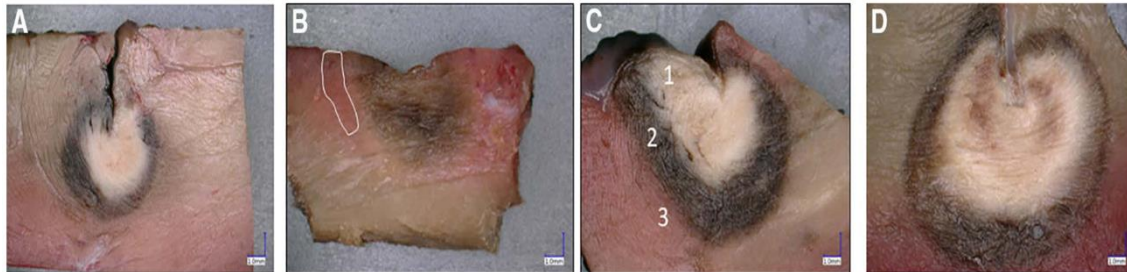


Sequential, co-localized RFA and PFA increases lesion size¹

Study Methods

- Ablation in swine ventricles
 - Four groups: RF only, PF only, RF then PF, PF then RF
 - Target PF index 300
 - RF: 50 W and 10 secs
- Tissues collected after 2 hours for lesion assessment

Study Results



RF only

PF only

RF then PF

Leading edge is PF histology

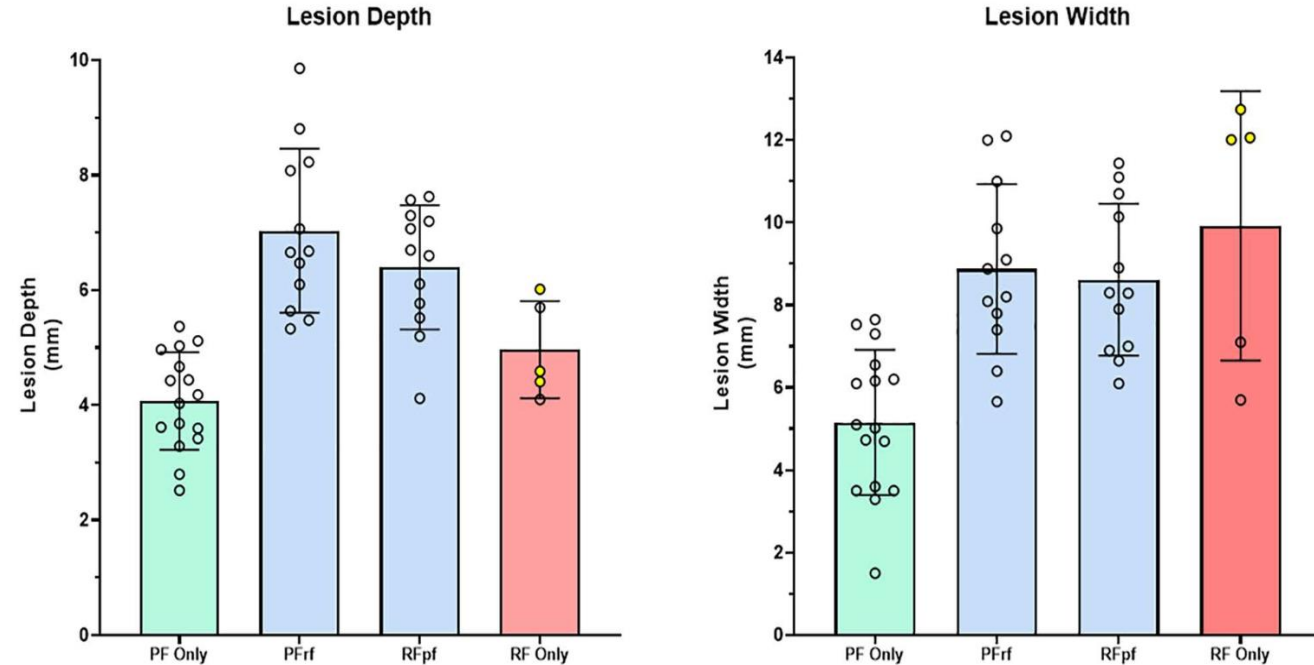
PF then RF

Leading edge is still PF

Zone 1 = pale; Zone 2 = dark; Zone 3 = thin hyperemic edge

Figure adapted from Verma A, et al. *Circulation: Arrhythmia and Electrophysiology*. 2025;18(2):e013143. The copyright belongs to the respective owners.

PF, pulsed field; PFrf, PF followed by sequential application of RF on the same location; RF, radiofrequency; RFpf, RF followed by sequential application of PF on the same location.



Conclusion

- Irrespective of order, the combined, co-localized application of RF and PF creates significantly increased lesion size compared with PF or RF alone
- The PF/RF combined lesion demonstrates typical PF changes at the periphery and RF changes in the center

1. Verma A, Maffre J, Tushar T, et al. Effect of sequential, co-localized radiofrequency and pulsed field ablation on cardiac lesion size and histology. *Circulation: Arrhythmia and Electrophysiology*. 2025;18(2):e013143.

Tack så mycket!

